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FARMERS' BULLETINS
Nos. 1601-1625

WITH CONTENTS

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COLLECTION AND PRESERVATION OF INSECTS FOR USE IN THE STUDY OF AGRICULTURE[1]

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THIS BULLETIN suggests methods of collecting, preparing, mounting, and preserving insect specimens for use by teachers of agriculture. It is intended particularly for those teachers who have not had special training along agricultural lines and who will therefore doubtless welcome specific information as to how to prepare materials needed for illustration and experimental use in the classroom.

WHAT MATERIALS SHOULD BE COLLECTED

In general, the illustrative materials with which every school should be provided may be grouped into two classes, according to the uses to which they are to be put: (1) Museum specimens and samples which are to be kept permanently for reference, display, and strictly illustrative purposes only; and (2) working collections, which may be used for display and illustration, but the chief purpose of which is to supply the students with materials for class study and experimental use. For instructional purposes the latter are far more valuable, but a permanent collection of insect specimens may be very useful to any school, provided, of course, the specimens are accurately labeled and so preserved and mounted that they are readily available for examination.

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[1] This is a revision, in part, of Farmers' Bulletin 606, Collection and Preservation of Insects and Other Material for Use in the Study of Agriculture, by C. H. Lane and Nathan Banks. It was prepared by the author with the cooperation of the specialists in the Taxonomic Unit, Bureau of Entomology.

[2] Transferred to the Plant Quarantine and Control Administration July 1, 1928.

Materials for class use should as far as possible be fresh and in the natural state rather than in mounted form, and will therefore generally be collected just prior to the time they are wanted, and put away only temporarily. No great degree of care or skill will, in general, be necessary to do this, but the preparation of materials for the permanent collection in a school museum often requires considerable technical knowledge and ingenuity in preparing and preserving the specimens and preparing convenient receptacles in which to keep them. This is particularly true where the means at hand are limited and the resourcefulness of the teacher must be relied upon to produce inexpensive methods and devices of home manufacture.

SOURCES OF MATERIAL

It is good policy to attempt, as far as possible, to have the pupils collect and prepare their own materials from original local sources, because of the possibilities for educative work involved in the process of gathering the various specimens.

Every community affords opportunities for collecting insects of vital importance in the study of agriculture, and the work of gathering these specimens will afford definite tasks upon which to center the interest of numerous field trips, so that the danger of aimless wandering, which so frequently makes this method of instruction devoid of practical results, may be minimized. The instructor who takes his class out into the field or orchard with the definite purpose of collecting insects has the very best possible opportunity at the same time to teach, not only identification of the local insect species but also useful facts regarding their economic importance.

In recent years many commercial houses and educational institutions have distributed collections of specimens and samples of various sorts to schools. Such collections are of great value, undoubtedly, and there is no objection whatsoever to schools securing materials from such sources whenever possible, so long as they do not rely upon these sources for all their illustrative material.

GENERAL SUGGESTIONS FOR FIELD WORK

It is important that the pupils be provided with notebooks and pencils for making the complete and accurate records which should be kept for each specimen collected. These records supply the data necessary for the proper labeling of the mounted specimen.

All work of this sort should be constructive and never destructive. Wanton destruction of insects, except those which are injurious to man or his crops, should be denounced and the young encouraged to watch the living insects and learn all they can of their habits.

SUGGESTIONS CONCERNING THE ARRANGEMENT OF MATERIALS

When insects are collected for ordinary purposes of study and reference, it will usually suffice to arrange the specimens in their logical order, that is, according to their scientific classifications. When, however, it is intended to prepare a set of specimens for an educational display, very interesting and attractive groups can be arranged to show strikingly the agricultural relationships of the particular insects in question. For example, a display might be centered about some farm insect pest which would show the insect in various stages of its development; specimens of the plants upon which it feeds, showing the injury it does to these plants; specimens of other insects which are hostile to it; and pictures of birds which prey upon it. It takes time to prepare exhibits such as this, but they are so much more attractive and instructive than an ordinary collection that the extra labor and thought involved in their preparation are fully warranted.

COLLECTION OF INSECTS

WHAT INSECTS TO COLLECT

When proper methods are followed, the collection of insect specimens can be made the basis of a great deal of useful instruction in connection with the subject of agriculture. There are numerous species that are really beneficial to the farmer, and these should, of course, be studied, but owing to the great number of species that are annoying about the house or injurious to farm animals or farm crops, insects are usually thought of as injurious to agricultural interests. These insect pests should form the basis of most of the work of the class in agriculture. It would be well, however, to make use of the forms which are most easily available at the season of the year when collections are being made and at the place in which the school is located.

In consideration of an insect from an economic standpoint all of its stages are important. It should therefore be the aim of the student of agriculture to observe the insect's habits and to preserve samples of all the stages in its life cycle. The pupil should seek to become familiar with each of the successive forms through which it passes in its development. In those insects which have a complete metamorphosis these forms are, normally, the egg, the larva (several stages), the pupa or resting stage, and the adult.

In addition to studying the cabinet specimens, field observations on the habits of living insects should be made. Such observations would include (1) the manner and place of deposition of the eggs, (2) characteristic work caused by feeding, (3) the selecting of places for hibernation, and (4) the relation of environment and season to the various steps in the development of the insect. In making such observations, samples to illustrate the feeding, construction of the nests, tunnels, galleries, or other architectural structures, as well as the cocoons or hibernating cells, should be preserved, as they will add greatly to the value and interest of the collection.

EQUIPMENT FOR INSECT-COLLECTING TRIPS

The articles necessary for collecting insects are not very numerous, and those which are most needed can be made by the pupils or the teacher with very little expense or trouble. The necessary equipment for an insect-collecting excursion should include collecting nets, killing bottles, a box containing some vials partly filled with alcohol, formaldehyde, or synthol, in which to place specimens of larvæ and pupæ, a trowel for digging specimens out of the earth, a small hatchet for breaking open rotten stumps, some sheets of newspaper or other soft paper about 3 by 5 inches in size, for making envelopes in which to put delicate specimens of butterflies, moths, dragon flies, etc., a small bottle of chloroform or gasoline, and a small hand satchel or haversack with a few small pasteboard boxes, such as pill boxes, in which to put insects after taking them out of the killing bottle. A small pair of forceps or tweezers will also be found convenient for handling some of the specimens, and a pocket lens will be a desirable aid for the study of specimens in the field.

THE INSECT NET

Anyone can make a satisfactory insect net. (Figs. 1 and 2.) All that is necessary is a bag of thin material, a ring to support the bag, and a handle to be fastened to the ring. Bags are made of various materials. For beating through weeds and bushes it is best to have a bag of stout material, as twilled muslin or light duck cloth. For capturing butterflies and most flying insects a light net of cheesecloth or unbleached scrim does very well for the beginner. The material should be such as not to stiffen or kink by use. Expert collectors often use bags of silk bolting cloth. Damaged bolting cloth which is satisfactory for making insect nets can often be obtained from flour mills.

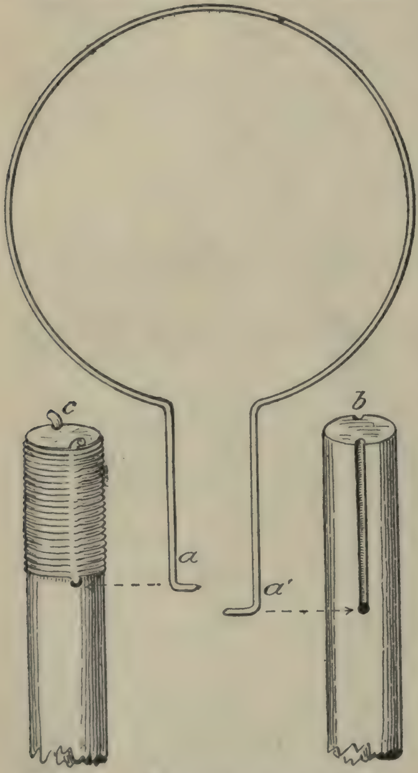

Figure 1.—Homemade ring and handle: a a', ring; b, stick showing grooves ending in hole; c, wire inserted in groove and hole and wrapped with twine

As a rule the length of the bag should be twice its diameter. The common size is 1 foot in diameter and 2 feet long. The bag is best if made to taper a little at the bottom, and the edges should be double hemmed (French seamed) so as to leave no free edge that may fray out. If the bag is of light material, it should be sewed to a band of stout muslin at the top. This band should be double and open at each end for the insertion of the ring, or else sewed on the ring. The ring may be of stiff iron wire at least an eighth of an inch in diameter. Bought rings usually have two or three joints to allow for folding, but although this is convenient for packing it is not important. The wire should be several inches longer than necessary to form the ring, the extra length bent nearly at right angles, and the last half inch bent at right angles. The stick or handle, about 2 or 2½ feet long, should be stout but not too heavy. A groove almost the size of the wire should be cut on each side near the end of the stick, ending in a hole, then the bent ends of the ring should be inserted in the hole and all wound tightly with twine, or a metal jacket slid over the ends to hold them in place. A longer and lighter handle of bamboo is better for collecting butterflies and dragon flies. It will be necessary to leave a few inches near the upper end of the bag unsewed so that the ring can be inserted in the band. This part can be laced up with a string and the ends of the string tied to the handle. This will keep the net from slipping around on the ring.

For catching small insects a " midget " net 5 to 7 inches in diameter is useful and can be made on the same plan as the larger one. The ends of the wire can be inserted in a spool and a stick for the handle wedged in between the ends of the wire. This net is very handy for collecting insects from flowers and, in fact, for general collecting. The material for the bag of the midget net should be very light; white China silk lining is a good material.

For collecting aquatic insects a more open mesh or sieve net can be attached to an iron frame which is straight on one side and bowed up on the other. With cords attached to each side this net can be thrown into the water and after it has sunk to the bottom can be drawn to the shore. Dredging among the weedy or sedgy parts of the pond is especially productive of insects.

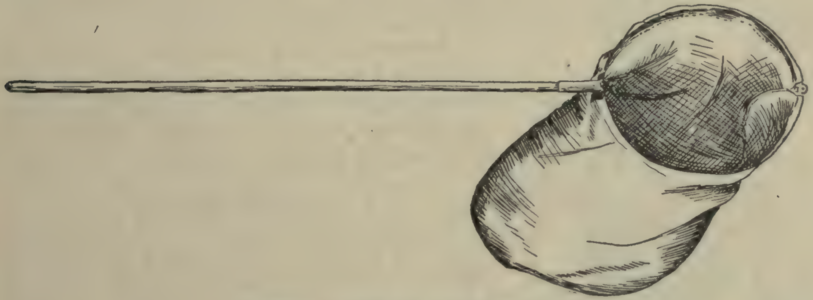

FIGURE 2.—Net for insect collecting

MISCELLANEOUS EQUIPMENT

Since many insects are attracted to lights, a strong lamp with a reflector to throw the light upon a white sheet will serve to attract many, particularly on sultry nights. A mixture of sugar or molasses and decaying apples smeared on trees in the woods will often attract moths and certain other insects at night. A good electric flash light or acetylene lamp is useful in examining these patches of sweetened bait in the evening. Many insects that occur on the trunks of trees can be captured easily by putting a small cyanide vial over them; thus one avoids handling the specimens.

For collecting insects from the branches and leaves of trees, a beating cloth is the most useful implement. It consists of a piece of heavy unbleached muslin a yard square with the corners turned over to form pockets. Two straight sticks about 5 feet long are placed cross-wise over the cloth with the ends placed in the pockets. To the center of the sticks another stick can be fastened, so that the cloth can be more easily held out under the branch. The beating cloth should be held in the left hand at arm's length under the tree, and the limb jarred with a heavy stick. A sudden shock will dislodge many beetles and other insects that would not have been noticed upon the tree. An inverted umbrella can also be used for this purpose but is much less convenient and serviceable.

Cans or bottles sunk in the ground so that the top is even with the top of the soil and baited with meat, a dead mouse, rotten apples, molasses, etc., will be visited by various insects. Boards or pieces of bark left on the ground near the edges of woods and meadows will serve as shelters for a variety of insects, and if visited occasionally will disclose many interesting specimens. Stones, logs, or boards should always be turned back after they have been examined so that they will continue to attract insects.

Many insects occur among dead leaves and moss. These may be sifted out on a white paper or cloth by the use of a sieve similar to an ash sieve but with a finer mesh. Some empty salve boxes or larger tin boxes for caterpillars and other larvæ should be taken along on collecting trips. Care is necessary in taking insects from a net so as not to crush them or rub the scales from the wings of butterflies and moths. Specimens should always be handled as little as possible.

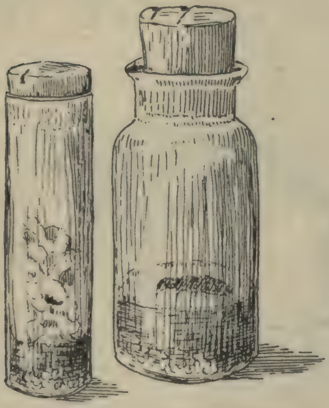

FIGURE 3.—Killing bottles

KILLING INSECTS

After the insect is caught it is necessary to kill it with as little pain to the creature as possible and without damaging the specimen. Insects are very differently organized from human beings, their sensations are perceived through much less perfect organs, and their brains are of such a very inferior nature that it is improbable that they feel much pain. Many insects can have their legs and other parts broken from them without incapacitating them in any way, and many kinds have parasites living within them and feeding on their internal organs without their exhibiting any sign of pain. There is no need, therefore, to feel that we are harming helpless creatures by collecting insects. Still, for the sake of the effect on the collector, it is not well to gather or destroy more than are necessary for this purpose.

The best way to kill insects is by cyanide vapor. Potassium cyanide and sodium cyanide are hard white substances which can be purchased at drug stores. Both are deadly poisons. The cyanide, if in chunks, should first be broken into small lumps. These are put into a bottle, covered lightly with dry plaster of Paris, and then plaster of Paris mixed with water is poured over them so as to cover the cyanide with a layer of set plaster about one-fourth of an inch thick. The bottle should be left open an hour or so to dry, and then kept tightly corked so that the fumes of the cyanide will be strong enough to kill an insect in a few moments. (Fig. 3.) A label with the word "POISON" in large letters should be pasted upon it. It is well to place some crumpled strips of soft paper in the bottle to absorb any moisture and to prevent the insects from shaking against one another. A well-made poison bottle will last several years. The bottle should be of thick glass that will not break easily, with a wide mouth and a tight-fitting cork that does not set down too far to be conveniently grasped for removal. Some make a poison bottle by wrapping bits of cyanide in soft paper and covering all with blotting paper wadded down in the bottom of the bottle. This does very well for a small bottle, but one should be very careful to have bottles of thick, tough glass. As stated before, cyanide is a deadly poison, and the greatest care must be exercised in handling it. Any cyanide left over or any cyanide bottle which is broken should be buried deeply in the ground. Poison bottles should not be left open in the room or placed where small children can get at them, and older children should be impressed with the possible danger. It is best that the teacher should have all the bottles returned after each collecting trip.

Specimens should not remain in the poison bottle more than a day or two. In fact, insects with yellow markings should not be left in over night as the yellow may turn to red. Moisture should not be allowed to collect and remain inside the bottle, or it will quickly spoil many insects, such as dragon flies. Most entomologists use many small cyanide vials or bottles of only about one-half to 1 inch diameter and 2 to 4 inches long. By taking several of these along on a trip, it is possible to keep insects of different sizes and kinds separate, for small flies are likely to get broken if put into the same bottle with large, heavy beetles. Never put other insects in a bottle that contains or has contained moths and butterflies, as the other insects will become covered by loose scales from the moths or butterflies. It should be noted that bees and other hairy insects should not be put in alcohol.

There is much less danger in handling insects than is popularly believed, since comparatively few species are poisonous or are likely to injure the collector by biting or stinging. Insects like the wasps and bees will sting, of course; a few of the larger beetles may pinch or bite; and certain bugs may pierce the skin with their beaks, but all these are well known and easily recognized by most people.

PINNING INSECTS

Common pins are too large for most insects, and so entomologists use a longer and more slender pin. These pins can be purchased from dealers in natural-history supplies. They are made of brass or steel, plated or japanned. Spring-steel pins are stiffer and preferable except in very moist climates, where they are likely to rust. Steel pins cost a little more than brass pins but are much better for most insects, since specimens mounted on them will not become covered with verdigris. Verdigris is a poisonous green substance formed by the corrosive effect of acids in the specimen upon the brass pin inside the insect, and may ruin the specimen or eventually destroy the pin. The pins come in numbered sizes. No. 2 is a very good size for most insects and No. 3 or No. 4 for the large ones. For use in school collections No. 2 will be the best size.

The larger insects, such as butterflies, moths, bees, and flies, should be pinned vertically through the body near the center of balance of the specimen. In butterflies and moths the pin must be through the middle of the thorax or the large wing muscles will not yield as the wings are moved in spreading them to dry. (Fig. 4.) It has been customary to pin several other groups of insects, like bees and flies, in the same manner, but whenever peculiar structures on the middle line will be injured by the pin, the latter should be inserted a little to the right of the median line. (Fig. 5.) Beetles (fig. 6) and many insects such as roaches, crickets, mantids, and large earwigs, are pinned through the right wing cover near the base. Walking sticks should be pinned through the metathorax (part of the body between middle and hind pairs of legs), or right tegmen (wing cover) if winged. Grasshoppers and katydids should be pinned through the base of the prothorax (the part of the body which carries the front legs) just to the right of the median carina, or keel; and in grasshoppers, etc., the left wings are frequently spread. (Fig. 7.) True bugs are pinned through the scutellum, or triangular portion of the thorax between the wings, slightly to the right of the middle line.

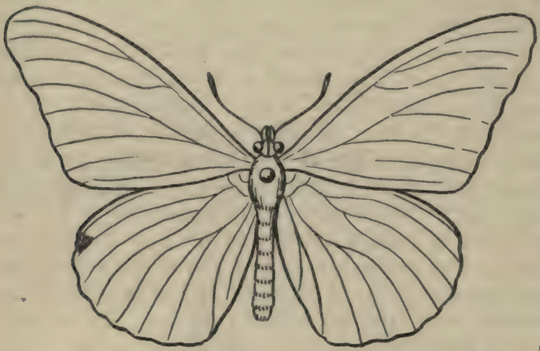

FIGURE 4.—Method of pinning butterflies

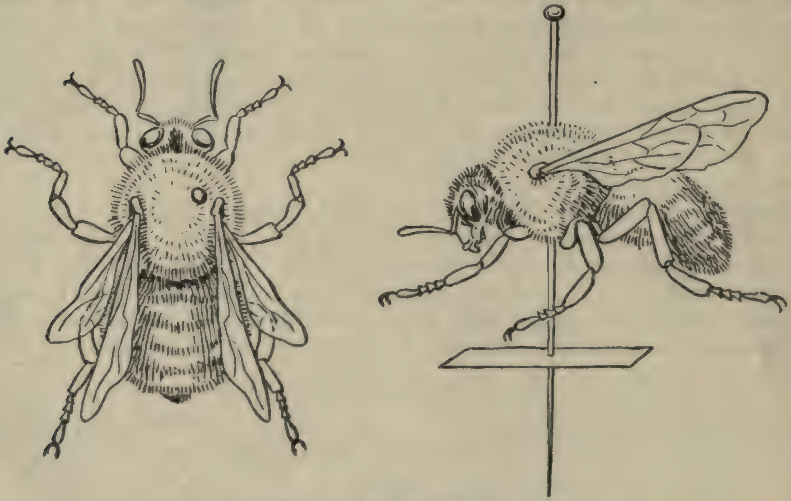

FIGURE 5.—Method of pinning bees

(Fig. 8.) The back of the specimen should be about an inch from the point of the pin.

Small moths should always be mounted on micropins (short pieces of slender wire having a pointed end) and spread as are larger moths.

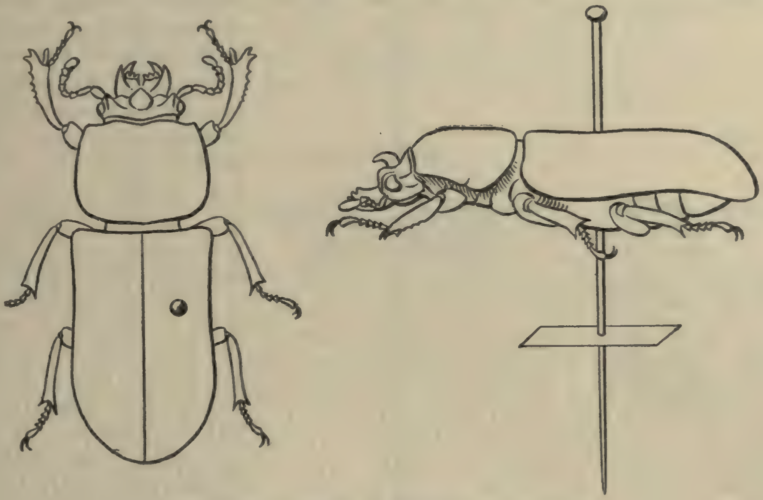

FIGURE 6.—Method of pinning large beetles

When dry such a specimen is attached to one end of a small oblong piece of cork supported at the other end by a larger insect pin, as in Figure 9, B.

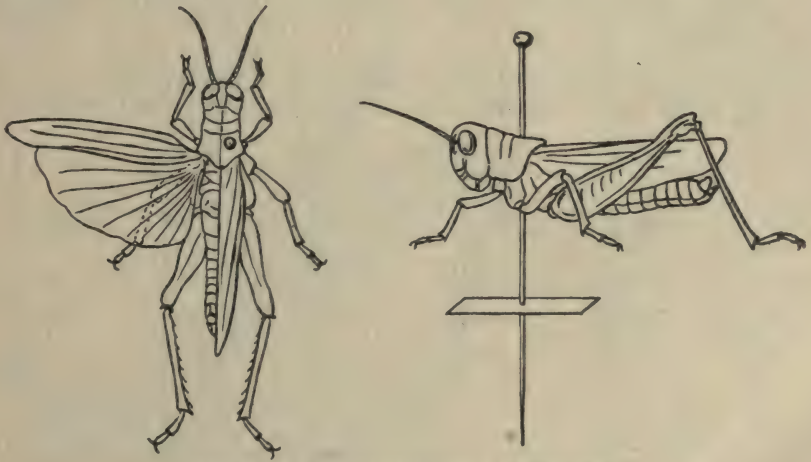

FIGURE 7.—Method of pinning grasshoppers

Small insects of most groups other than moths are best cemented onto triangular card points. The card points (about one-third inch long) may be cut from good stiff linen paper. A pin should be inserted through and close to the broad end, a little glue or shellac put on the point, and the insect laid upon it with the back outward or upward and its head away from the preparator when the point is to the left of the pin. (Fig. 10.) It must always be remembered that specimens are mounted for study of their parts, and that neither the adhesive nor the paper point should cover more than is necessary to hold the specimen. Thus the practice for mounting small beetles is that the point with its droplet of cement should be applied to the metasternum (underside between the middle and hind legs, but should not reach the middle line. If specimens are large enough, the gummed point may be inserted into a small cut made in this plate (metasternum) with a flattened pin. Small bugs (Hemiptera) are also glued with the back up rather than on the side. Ants should always be mounted on card points, usually with three points on each pin. If possible, a male, a female, and a worker of the same species of ant should be mounted on one pin; but in any case the three specimens must be of the same species.

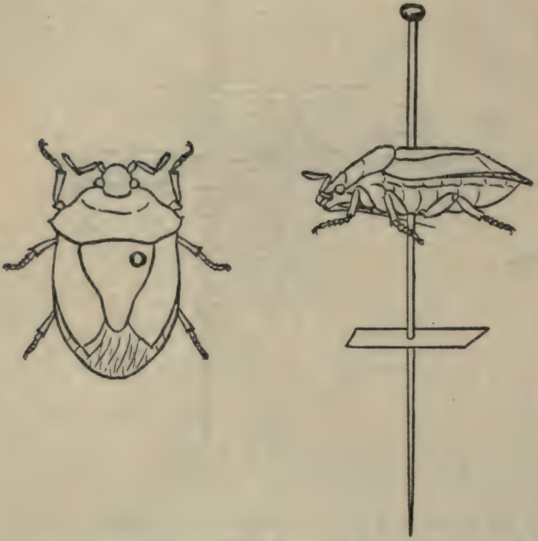

FIGURE 8.—Method of pinning bugs

It is very important that all specimens be correctly named before they are permanently assigned to a place in the school collection. Entomologists usually have little 2-lined or 3-lined labels printed in very small type, giving the locality where the specimen was captured and a blank space for writing in the date of capture. These labels are put well up on the pin, a little below the insect, so as not to interfere with the legs. For school purposes labels may be written with a fine pen, care being taken to write them in a

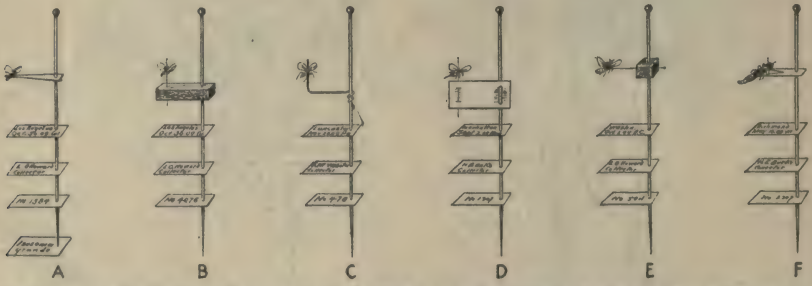

FIGURE 9.—Micro mounts: A, the card point; B, micropin in cork; C, elbow pin; D, micropin in card; E, micropin thrust through side of specimen; F, double card point

small and neat hand. Insects found eating plants should have a little label giving the name of the plant, and the entomologist also usually places on a label the name of the collector of the specimen. Pupils should be impressed with the idea that carefulness in these little details counts in the value and usefulness of a collection. Additional information and aid along this line may frequently be had from the State agricultural college or experiment station or from officials of the State department of agriculture.

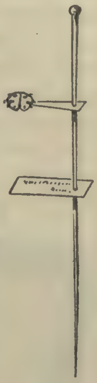

Figure 10.—Method of mounting small insects

SPREADING INSECTS

Insects should be prepared and mounted as soon as possible after they are collected, for if they are left for any length of time the wings and legs will become stiff and easily broken, and it will be impossible to spread the wings, as will often be desirable, in order to give the specimen a lifelike and attractive appearance. If it should be impossible to mount the specimens until they have become rigid, they can be relaxed by placing them for a time on a piece of paper in a box partly filled with moist sand. It will be well to put a few drops of carbolic acid on the sand in order to prevent molding. After being left in this way for two or three days the insects will usually be sufficiently relaxed to make it possible to mount them without great difficulty. Small insects such as microlepidoptera will only need to be left in overnight.

Butterflies and moths, dragon flies, and similar insects should have their wings spread out at right angles to the body. This is done by the use of a spreading board such as is shown in Figure 11. Two strips of some soft wood, such as linden, white pine, or yellow poplar, are fastened on low cleats resting on a bottom board. A strip of cork is fastened to the underside of the strips to cover the groove between them. The pin is pushed through the cork until the body of the insect rests upon it, and the wings are then stretched out on the boards by pulling them forward with a pin inserted near the front margin. They should be pulled out far enough so that the hind margin of the front wings will form a straight line. Then the wings should be held in place by strips of paper pinned down tightly at each end. The specimen should remain on the spreading board for at least a week, so that when removed the

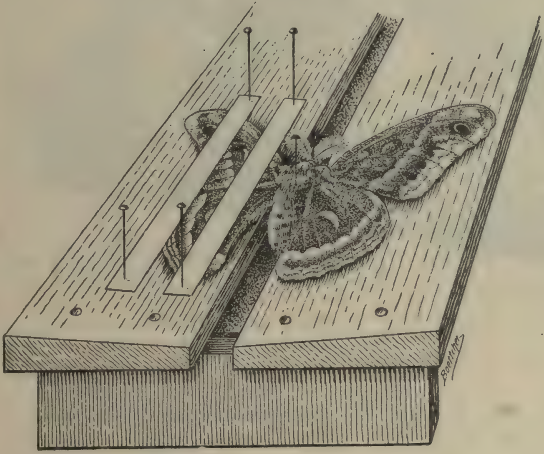

Figure 11.—Spreading board

wings will stay spread and not relax to the normal condition. Care should be taken in placing the strips across the wings, so as not to rub the scales from the wings of butterflies and moths. With grasshoppers it has been customary to spread the wings of one side only. Specimens of dragon flies on the spreading board should be dried as quickly as possible to preserve the body colors; to accomplish this the spreading board is sometimes placed in an oven and heated very gently. If heat is not applied, at least two weeks should be allowed for the dragon flies to dry before removing them from the board. Before mounting a dragon fly it is well to run a bristle through the head, thorax, and abdomen to keep the body from breaking apart, as is pretty sure to happen if this is not done.

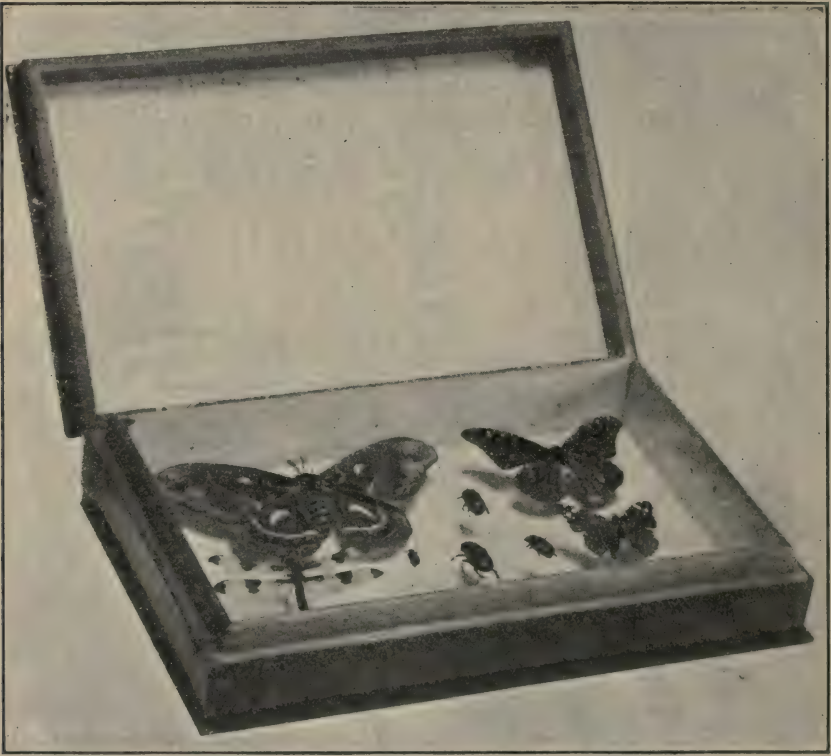

FIGURE 12.—Covered box for insect specimens, commonly known as a Schmitt box

BOXES

If it is desired to keep the insects for several years, it is necessary to put them in a tight, dry, and dark box—tight to exclude other insects which would eat them, dry to prevent mold, and dark to preserve their colors.

There are two sizes of boxes commonly used by collectors. One is a box about 9 by 12 inches with a hinged top. (Fig. 12.) These may be stood on edge on a shelf. The other is a larger box or drawer about 15 by 18 inches with a removable glass top. These drawers are arranged to slide into a cabinet. Cabinets, with three or more drawers, that will be excellent for school collections, can be purchased from dealers. For the purpose of temporary study insects can be kept in any style of box with a cover. Cigar boxes will do for a time (fig. 13), but are sure to become infested with insect pests if neglected long. The bottom of the box should be lined with some soft material, such as cork, peat, well-dried corn pith, or corrugated paper, and covered with soft paper. To prevent other insects from coming in and eating the specimens, a teaspoonful of flake or powdered naphthalene should be placed in each box. Within the box the specimens should be arranged, each kind by itself in a row. A label with the name of the insect can be placed behind the row of each species or attached to the first specimen in the row.

In recent years a new mount has been developed for exhibiting insects and their life histories, and it is most excellent for use in schools. It consists of a pasteboard box about one-half inch deep, the top having a glass cover. (Fig. 14.) This box is filled, not too tightly, with cotton. The insect is spread out on the cotton, the top pressed down and held by pins. These mounts can be purchased from dealers and are very useful for passing around in a class, or may be hung as pictures on the walls of the schoolroom. The eggs, caterpillar, chrysalis, and the adult, as well as part of the plant eaten, can all be put in the same mount and thus exhibit the life history of the insect.

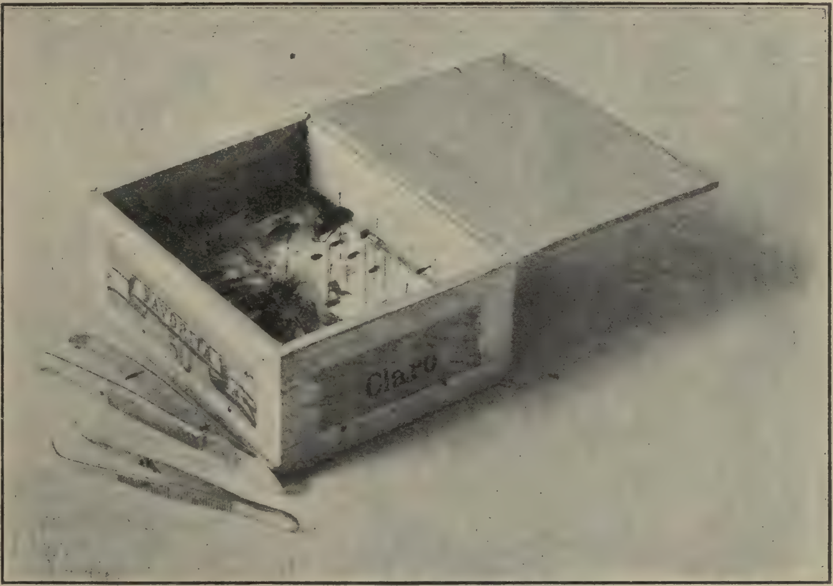

FIGURE 13.—Cigar box for insects

FUMIGATION OF SPECIMENS

To fumigate the specimens perhaps the best way is to place in the box with the specimens a small tin lid or other small shallow vessel and put into it about a tablespoonful of the nonexplosive carbon tetrachloride or of carbon disulphide. The fumes of the latter substance are inflammable and explosive when mixed with air in certain proportions and should not be handled near a fire. The fumes from these substances are annoying and disagreeable, hence it will be advisable to do this fumigating out of doors, or in an outbuilding—never in the schoolroom. Paradichlorobenzene, which is a white crystalline substance, is also a good fumigant, is not explosive, does not have so objectionable an odor as carbon disulphide, and can be used in much the same way as naphthalene.

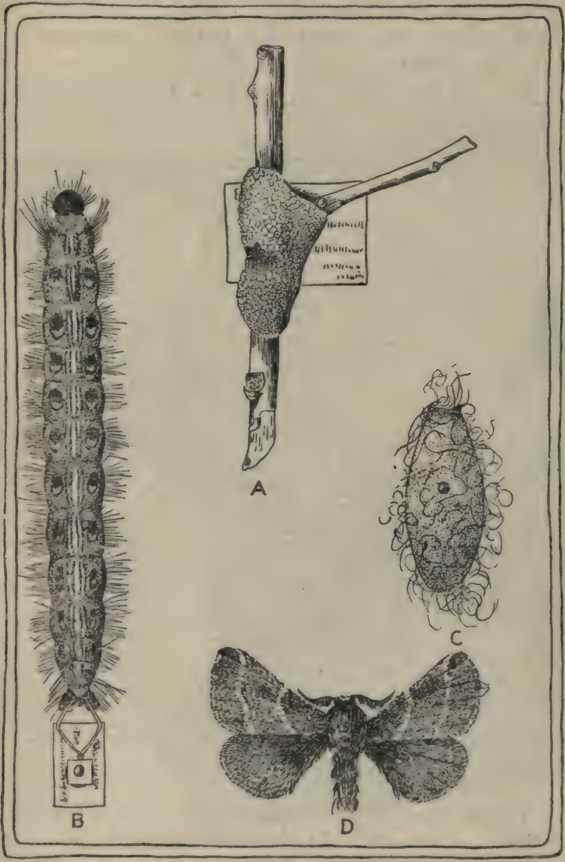

FIGURE 14.—Series of specimens illustrating life history of a moth: A, eggs; B, inflated larva; C, cocoon; D, adult

PRESERVING THE IMMATURE STAGES OF INSECTS

The specimens illustrating the life histories of insects will not be complete unless the larvæ are preserved, and it is often in this form that the creature is most injurious to crops. Furthermore, there are some soft-bodied insects, like the spiders, which are difficult to preserve dry.[2] These specimens should, therefore, be preserved in fluids.

There are two methods of preserving the larvæ of moths and butterflies — by inflation and drying or by placing them in solution. For the larger forms, particularly where these are to be used for demonstration or classroom exhibition, the former is preferred; but for all purposes of study of the caterpillars themselves the second is the better method.

To inflate larvæ, first put them on a piece of blotting paper and press out the body contents by rolling with a clean piece of glass tubing, starting from the thorax just back of the head and continuing to the end of the abdomen, exerting just enough pressure to force out the entire body contents and not enough to break off the fine spines or hairs. A piece of glass tubing which has been drawn to a rather long point is then inserted in the anal opening of the caterpillar and the caterpillar fastened to it by a clip or other piece of metal formed of a piece of watch spring. (Fig. 15.) The caterpillar is then distended by forcing air by hand or foot bellows into the tube, care being taken not to use too much force and thus distort the caterpillar. While in this condition it is dried in an oven hot enough to bake thoroughly without scorching the insect. Various types of apparatus for the blowing of caterpillars are to be had from entomological supply houses. The ingenious student, however, can easily make a cheap one of his own. All that is required is a spirit lamp, a tin can, a stand for same, glass tubing, a bit of watch spring, and a hand bulb or bellows. When the caterpillar is thoroughly dry it is removed from the glass rod and mounted. Figure 16 shows the best type of mount. A bit of glue should be put on the wire to hold the caterpillar in place. The advantage of this method of preservation is that the caterpillar can be pinned in the case along with the adult insects. When the inflation has been carefully done, the caterpillars present a lifelike appearance, retaining most of their spines, markings, and color.

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[2] Spiders, soft insects, and most larvæ can be dried without collapse by a modification of the Semper method, but as this demands the use of alcohol free from water (technically known as absolute alcohol) it can be practiced only where this is available. The method is to arrange and harden the desired preparation in a good fixative, thoroughly dehydrate by alcohol, puncturing tissues with a fine needle to prevent collapse from osmosis, clear in xylol, and dry.

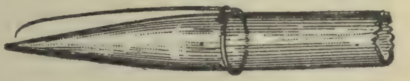

FIGURE 15.—Tube for distending a caterpillar

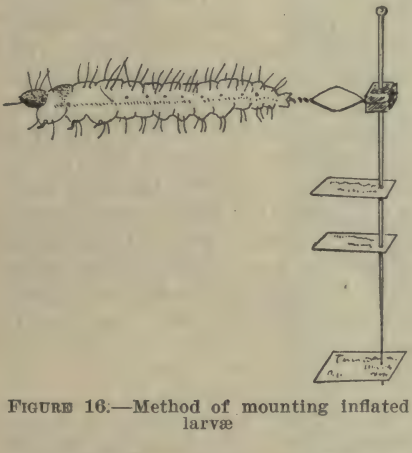

FIGURE 16.—Method of mounting inflated larvæ

The best method, however, for preserving immature stages—not only of moths and butterflies but also of beetles and flies—is in liquid preservative. The caterpillars or grubs are first killed by dropping them into boiling water, removing the water from the blaze, and allowing the insects to remain in the water for from three to five minutes, depending upon their size. They are then removed and placed directly in a solution of 80 to 95 per cent alcohol. For the smaller caterpillars and all fly larvæ the 80 per cent solution is best. For the larger caterpillars, whose bodies contain a considerable quantity of moisture, 95 per cent alcohol is to be preferred. To insure against shrinkage and to keep the body parts soft, a little glycerine—not over 2 ounces to the quart—should be added to the alcohol. Pupæ should be preserved in fluid in the same way as the caterpillars. In all cases where immature stages are preserved, whether by inflation or in fluid, they should be carefully labeled with full data as to locality, date, collector, and food plant; and where they are preserved in connection with rearing experiments, there should be some ready means of associating them with the adults.

MOUNTING MINUTE SPECIMENS

In determining all parasitic Hymenoptera (the order of insects containing bees, wasps, ants, etc.) it is necessary to see the antennæ, legs, propodeum,[3] dorsum (back or upper part) of abdomen, and wing venation. The wings, antennæ (feelers), and the legs of a part of the specimens should therefore be spread. This is especially true of the minute parasites belonging to the groups known as Chalcidoidea and Serphoidea. This can easily be done by taking the specimen from alcohol, placing it on its back on a clean microscope slide, and spreading the wings, antennæ, and legs with a brush while wet and then permitting them to dry. The specimen will dry in a very few minutes, and the parts will keep their position. It can then be mounted on a card point.

Only the very minute forms should be mounted in balsam. Those to be so mounted should be handled as follows: The specimens are killed in a solution containing—

	Cubic centimeters
Acetic acid (33 per cent)	62.5
Hydrargyri perchloride (liquid)	62.5
Glycerine	62.5
Alcohol (90 per cent)	500
Distilled water	312.5

They are kept in this solution until they are to be mounted, and will remain soft in it for years. Before mounting, the specimen is soaked in pure water for 24 hours. It is then placed in a drop of water on a cover slip and this put on a microscope slide. The slide with cover glass is placed under a binocular microscope and then the specimen is spread, as indicated above, upon the cover glass. While still damp the wings, antennæ, and legs are brushed over with a thin solution of gum arabic in water. This will dry immediately and fix the specimen to the cover glass. When thoroughly dry the specimen should be touched with a small drop of xylol and then covered with a drop of balsam. Let this balsam harden somewhat, then place another drop of balsam on the middle of the slide, pick up the cover glass with a pair of forceps, turn it over, and place it over the fresh drop of balsam. This brings the specimen with its back up, and if properly done will make a good mount.

KEEPING LIVE INSECTS—BREEDING CAGES

One of the most interesting phases of insect study is the rearing of insects. The simplest way is to collect the cocoons, attached to various trees in the fall, and the moths, red, brown, or pea green, will appear the following spring. It is more instructive, however, to collect the larvæ or caterpillars and place them in a box where they can be supplied each day with the proper kind of leaves for food. By this means one can watch the caterpillars change their skins while they grow, and also note the change from the caterpillar to the pupa or chrysalis. The last larval skin shed by the insect larva on pupating and the pupal skin should be saved, together with the adult that issues from it. Any box with a top of netting to prevent the caterpillars from getting out will be suitable. By putting moist sand in the bottom of the box, the food will keep fresh a longer time.

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[3] The part of the thorax immediately over and partly surrounding the petiole, or first segment, of the abdomen.

A very convenient and useful breeding cage is made by putting a lamp chimney in a flowerpot (fig. 17), the top of the chimney covered with a piece of gauze or mosquito netting. If the pot rests in a saucer containing water the sand or earth in the pot can be kept moist so that the twigs of the food plant will remain fresh for some time.

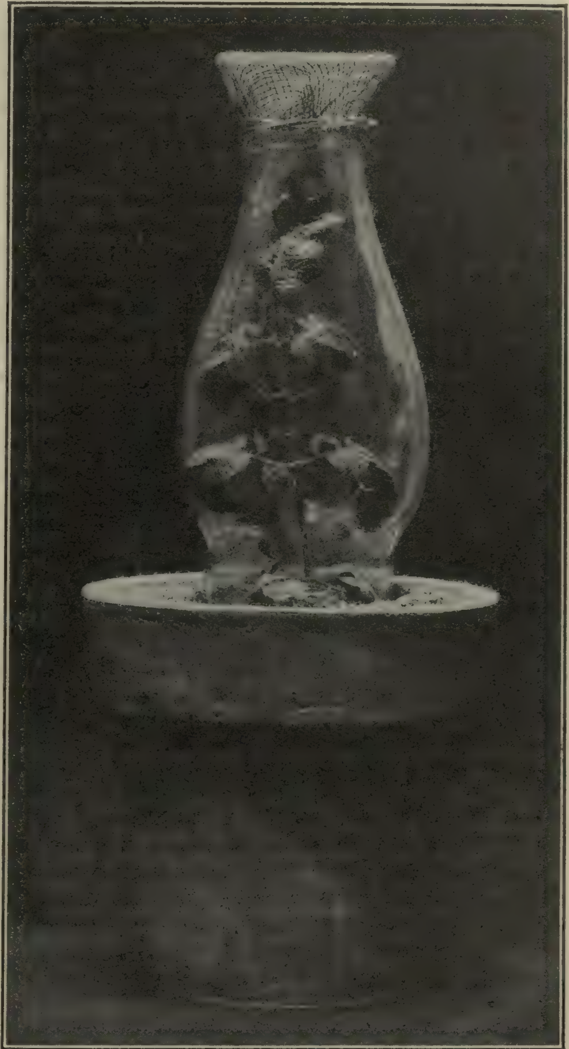

FIGURE 17.—A simple breeding cage for insects

It is interesting to keep ants in an artificial nest. A simple one may be made by taking a piece of board at least 1½ inches thick and about 12 inches square and making a channel 1 inch wide and three-fourths of an inch deep all around near the edge. This channel should be nearly filled with water. On the center of the board put two pieces of glass about 8 inches square and between them a thin layer of soil or comminuted wood. Cover the top glass with a blackened board or tin. Ants placed between the plates of glass will excavate tunnels and if fed may be kept a long time.

If galls of insects are collected in the fall or winter many specimens will issue in the spring. Twigs of oak and other trees blown off in the fall or winter may contain beetles, and if placed in a room the insects will issue and fly to the windows. In rearing moths or other insects one sometimes finds that instead of the expected specimen there appears a quite different insect. This is usually an ichneumon fly or tachina fly. The young of these live parasitically in the caterpillar and destroy it. These parasites should be saved and when possible the name of their insect host should be put on the label.

A good breeding cage (fig. 18) for parasites is a wooden box 10 or 12 inches long and 6 to 8 inches wide and of about the same depth. This box is fitted with an inner cover of glass and an outer cover of wood. One can therefore examine the material without permitting the escape of the insects. In one side of the cage several holes are bored and a glass tube fitted into each. The insects will be attracted by the light and come out into the tubes. The tubes can be quickly removed, the hole stopped with cotton, and the insects dumped into a cyanide bottle. For insects that pupate in the soil a layer of sand can be put into the bottom of this box.

Aquatic insects may be reared in a large Mason fruit jar, or a jar made especially for this purpose may be purchased from the dealers. Put some sand and pebbles in the bottom, fill with fresh water, and put in some fresh-water plants. The main difficulty is in the water becoming stale. All decaying matter and uneaten food should be removed with a pipette or long glass tube. It does not pay to try to keep too many kinds of insects in the same aquarium. Where a flow of water is available, a siphon outlet can be arranged and fresh water insured all the time. Many aquatic larvæ will not develop properly unless in running water. If near a stream, a cage of wire screening can be arranged over a stone or plant in the water on which are the larvæ of the desired insects.

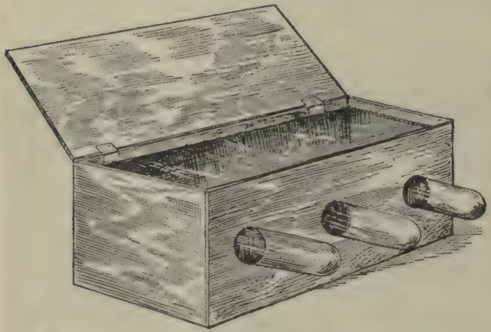

FIGURE 18.—A breeding cage for parasites

SHIPPING INSECTS

Probably many specimens will be discovered which can not be determined with the books available and it may be desired to send these to specialists for determination. To aid in building up collections it is often desirable to exchange specimens with other workers. To insure that these specimens reach their destination safely, they should be carefully packed for shipping. If the directions given below are followed, there is very little danger that specimens will be broken in shipping.

PINNED SPECIMENS

Pins must be firmly placed in the cork lining on the bottom of the insect box. All large and heavy-bodied insects should have a guard pin placed on each side and extending obliquely so as to meet above the top of the insect. This will prevent its moving on the pin which goes through the insect. The box containing the specimens should be wrapped with paper and then surrounded by at least 2 inches of some loose packing material, such as cotton or excelsior, which should in its turn be surrounded by a rigid covering. For comparatively small-sized packages corrugated paper makes a satisfactory covering.

Larger packages should be inclosed either in a stiff cardboard or light wooden box. The cotton or other material used for packing should not be put in too tightly, as its purpose is to absorb any shocks which the package may receive in transit. If the packing material is too tight, the purpose of it is lost.

ALCOHOLIC MATERIAL

In shipping material preserved in alcohol or other fluids, each vial should be tightly corked, wrapped in soft paper, and surrounded by some loose packing material. When only one or two vials are sent, they may be wrapped in cotton and placed in a wooden or pasteboard mailing tube manufactured for such purposes. The cotton packing around the vial should not be crowded in too tightly. When many vials are to be sent, they should be separated from each other by packing material and inclosed in a stout wooden or tin box.

In shipping specimens the usual directions required in connection with parcel post and express shipments should be followed. The word "Fragile" should be marked conspicuously on the wrapper. Always put the name and address of the sender on the package. Packages sent to foreign countries should be marked "Natural history specimens, no commercial value."

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

July 24, 1929

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REED CANARY GRASS

By H. A. Schoth, *Associate Agronomist, Office of Forage Crops and Diseases, Bureau of Plant Industry*[1]

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ORIGIN AND HISTORY

REED CANARY GRASS (*Phalaris arundinacea* L.), while not a new grass in either hemisphere, is one of the latest to assume a rôle of increasing importance. In the United States it is found from the New England States westward to the Pacific coast and as far south as Tennessee. The grass is native to the temperate portions of Europe, Asia, and North America.

The cultivation of reed canary grass began in England about 1824 and in Germany about 1850. Cultivation in the United States probably began along the north Atlantic coast shortly after its early use in Europe. At the present time, however, the Pacific coast sections of Oregon, Washington, and northern California have the largest areas of this grass.

According to reasonably authentic records, it was first cultivated in the Coquille Valley of Coos County, Oreg., about 1885, and the original stand is still in existence. A majority of the fields on the Pacific coast can be traced to this early seeding. In various sections of the northern Rocky Mountain States and in southern Canada considerable areas of reed canary grass are found. The origin of the first fields in these sections is not known, but many of them are perhaps native.

An expansion in the acreage of this grass in many sections of the eastern United States is indicated by the increasing quantities of seed purchased. Many new seedings are also being made in the North Central States. Reports indicate that successful stands are being obtained and that forage yields are high.

No diseases serious enough to attract any attention attack this grass, and at present it is troubled very little by insects. During occasional years when grasshoppers and cutworms are numerous, slight damage is done.

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[1] This bulletin is based on cooperative investigations by the Office of Forage Crops and Diseases, Bureau of Plant Industry, and the Oregon Agricultural Experiment Station, Corvallis, Oreg.

DESCRIPTION

Reed canary grass is a coarse perennial 2 to 8 feet tall with leafy stems, usually stout enough to prevent lodging, tending to grow in dense tussocks or bunches 2 to 3 feet in diameter and spreading underground by short, scaly, creeping branches or rootstocks. The leaves of the ordinary variety are broad, smooth, and light green in color; the inflorescence is a semidense, spikelike panicle varying from 2 to 8 inches in length. (Fig. 1.)

The seeds are oblong, blackish, brown, or gray in color, smooth, and free from lint or chaff. Well-matured, clean seed weighs 44 to 48 pounds per bushel.

The seeds mature from the top of the panicle downward and shatter very easily after ripening, especially if the weather is dry and warm. Good seed will test 95 to 98 per cent purity. The purity is high because in general where reed canary grass grows few grasses or plants are found whose seeds will get mixed with it. Germination varies from 20 to 90 per cent; low germination is due partly to immature seeds. These are always present as the result of early harvesting to prevent loss from shattering. Some of the seed germinates very slowly, which may be an additional reason for the thin stands often obtained. There are approximately 564,000 seeds in 1 pound.

There are numerous variations in the ordinary variety of reed canary grass. Several of these have been segregated and are being tested in sections where the grass thrives. A variety with variegated leaves and botanically known as *Phalaris arundinacea picta*, commonly called ribbon grass, is grown as an ornamental.

CLIMATIC ADAPTATIONS

Reed canary grass does best where the climate is moist and cool; but it is not sensitive to heat or cold, growing successfully where winter temperatures drop below zero and where summer temperatures occasionally reach 100° F. Where average mean minimum temperatures in winter are above 45° or average mean maximum temperatures in summer are above 80°, however, it is not very successful. Cool weather is especially desirable during the winter dormant period. (Fig. 2.)

SOIL REQUIREMENTS

Reed canary grass makes its best growth on fertile, moist, or swampy soils, is especially suited to swampy or overflowed lands of a sandy, mucky, or peaty nature, and makes an excellent growth on loams and clays of good fertility. The grass is not suited to salt marsh or alkali soils. Moving overflow is not detrimental to this grass during either the dormant or the growing season. Deep-ponded water is not especially injurious to it when dormant, if it does not remain too long, but deep-ponded water during the growing season usually results in considerable loss of plants. Winter overflow is apparently beneficial, because there is practically always increased growth following an overflow season.

Although naturally a moist or wet land grass, it makes a very good growth on high, well-drained, productive soil if supplied with ample moisture for spring and early-summer growth. Its moisture-loving habits make it adapted to irrigation in cool climates.

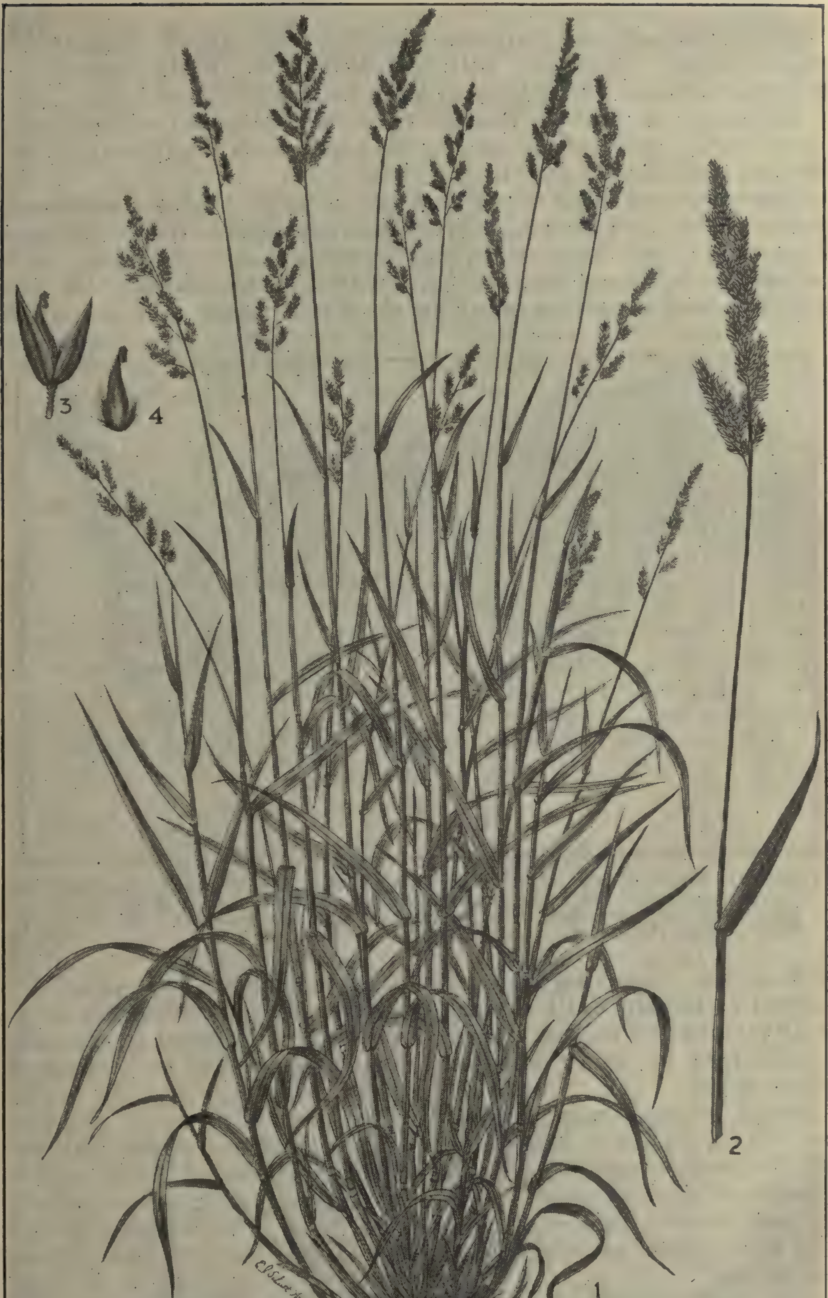

FIGURE 1.—Reed canary grass (*Phalaris arundinacea* L.) ; 1, Plant showing habit (about one-sixth natural size) ; 2, a panicle (slightly reduced) ; 3, floret (much enlarged) ; 4, single spikelet (much enlarged)

SEED-BED PREPARATION

Four kinds of seed beds are used for reed canary grass on the Pacific slope. These are well-cultivated land, newly slashed and burned-over land, semicultivated land, and uncultivated land.

The most satisfactory stands are usually obtained on well-cultivated land. Seed-bed preparation should be such that the soil is fine, firm, and reasonably free from weeds.

The next most satisfactory seed bed is brush land or timberland, newly slashed and burned over. Most land under these conditions is reasonably free from weeds, and the natural ashy seed bed is often as good as or better than can be prepared by machinery. On land suited to reed canary grass along the Pacific coast it is very often used as the "breaking in" crop after slashing. The stands are allowed to remain until the stumps have decayed sufficiently to be easily removed by pulling. After the stumps are cleared off, the land may be used for other crops or the stand thickened by seeding in vacant spots.

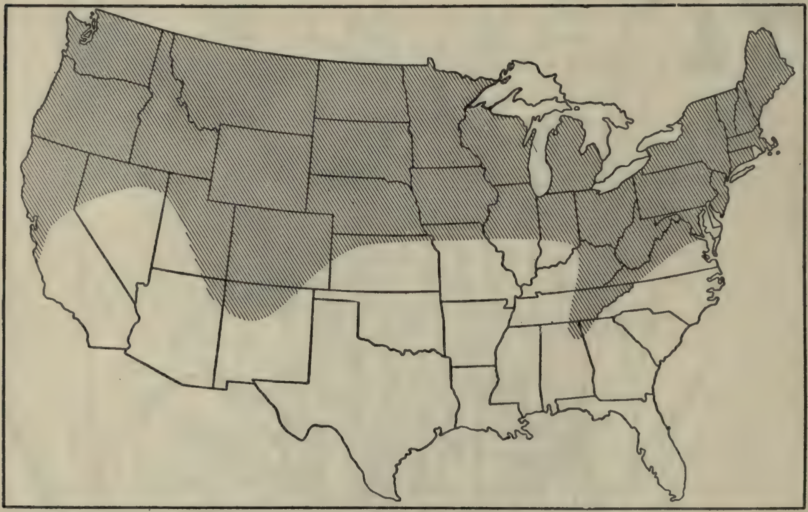

FIGURE 2.—Region of the United States to which reed canary grass is adapted. In the dry sections of the Rocky Mountain States and in the Great Basin it can be grown only when irrigated, except in the high mountain meadows where moisture conditions are favorable

Rough, semicultivated lands are often used if suited by moisture and soil conditions to this grass. Any cultural operations that will stir the surface and form a partial seed bed are of much help in obtaining a stand of grass. Disk or spring-tooth harrows are usually the most suitable implements for this purpose. The degree of success with this method usually depends very largely on favorable natural conditions.

The most unsatisfactory seed bed for reed canary grass is the uncultivated or unburned one. Seeding this grass on land with a growth of brush or grass or both affords a chance for only a partial stand. Occasionally partial success is obtained by seeding on the mud as the water recedes from swampy land that is not too brushy or grassy. On these lands, however, after a few plants are established the vegetative spread of these and the natural distribution of the seed produced by them sometimes result in considerable areas becoming well stocked with reed canary grass plants.

DATE OF SEEDING

Both fall and spring seedings are successful on the Pacific coast, but in the Central and Eastern States it is best to seed in the early spring. Where winter temperatures do not cause heaving of the young seedlings and winter overflows do not occur until the seeds are germinated and the seedlings well established, fall seeding on reasonably well-prepared seed beds is satisfactory. On burned-over lands fall seeding is better than spring seeding, as the land is in better condition, no further seed-bed preparation is necessary, and the full value of the ashes is realized.

In general, in most of the reed canary grass sections spring seeding is most satisfactory on cultivated lands. On these lands a longer seeding season is usually possible, good seed beds can more easily be prepared, and there is little danger from overflow on low land. Where these conditions exist, seedings may be made from February to June, depending on climatic and soil-moisture conditions.

Reed canary grass seed germinates very slowly. Under ordinary temperature and moisture conditions it takes from 24 to 40 days for complete germination. This point must be considered in making fall seedings. When seeding in the fall on land that may overflow it is especially advisable to seed early so the seed will not wash away and the seedlings will be well enough established to resist washing or drowning out.

RATE OF SEEDING

On well-prepared seed beds where ample moisture is available for maximum germination and continuous growth and the probability of plant loss is small, 5 to 8 pounds of good seed to the acre are used by many farmers and excellent stands obtained. Because of the high price of seed, the use of larger quantities to act as an insurance of good stands on land receiving little or no seed-bed preparation is a practice of doubtful value. Thin stands gradually improve if the land is suited to the crop.

METHOD OF SEEDING

Several methods of sowing are practiced. Fall seedings are nearly always made alone, either with a grass-seed drill or a grass-seeding attachment on a grain drill or by broadcasting. The seed should be covered very lightly, not over 1 inch. Broadcast seed can be covered sufficiently with a brush drag or a spike-tooth harrow with the teeth inclined backward at an angle of 45°.

Reed canary grass is seldom sown in combination with other grasses, but it may be sown with small grains. Combination seedings are usually made on land of good fertility and plentiful moisture supply. When seeding with a companion crop the seed may be sown with a grass-seeding attachment on the grain drill or broadcast either before or after drilling the grain. In order to cover as much seed as possible it is advisable to give the field a light dragging or harrowing after either method of seeding.

Sowing alone in the spring usually gives the most uniform stands, but spring seedings are often made with a small grain on low, fertile soils plentifully supplied with moisture during the summer. This practice is very common in western Oregon and western Washington. Spring oats or barley are generally used. Usually after the grain crop is harvested the new stand of grass is large enough to furnish considerable fall and early-winter pasture.

Fall seedings with winter grain are sometimes made if the land is adapted to both crops. However, lands dry enough to produce fall grain are of doubtful value for reed canary grass unless they may be irrigated. Combination fall seedings should be made during September or early October.

Seedings of reed canary grass in cultivated rows on rather dry upland have been successful in several sections. The seedings made either in the fall or in the spring in rows 16 to 20 inches apart are cultivated the first year. This results in the establishment of a good root system and thrifty plants. During the second year the plants spreading by means of their rootstocks usually occupy most of the spaces between the rows and an almost solid stand is obtained.

Small areas to be used as nurseries or seed plots may be planted vegetatively. The rootstocks grow very readily. It is good practice to cultivate the first season unless the rootstocks are planted close together on fertile, moist soil. They should be set at intervals of 8 to 12 inches about 2 inches deep. This method may be useful where it is desired to propagate certain special strains.

USE AND VALUE AS PASTURE

Reed canary grass is primarily a pasture grass. Its long life, long grazing season, and the large quantity of very succulent, palatable forage produced make it a valuable pasture plant where it thrives.

Because of the type of land on which it makes the most growth, as well as its rapidity of growth, it is better suited to dairy or beef cattle than to sheep or other kinds of livestock. The rapid, rather soft growth makes it a somewhat washy feed. Many dairymen feed a ration of grain with a small quantity of concentrate to offset this characteristic and, as they say, "to give it more body." On overflowed or low, rather swampy land in sections where winters are open the pasture season is usually the time between flood periods or as soon as the land gets firm enough to hold the stock. Along the Pacific coast good stands on reasonably well-drained land furnish pasture for nine months each year; on higher, drier lands the effective pasturing season is not so long. In sections where long winters occur the pasture season can usually be considered as extending from shortly after the last heavy frosts in the spring to the early heavy freezes in the fall.

Under Pacific coast conditions 1 acre of good reed canary grass pasture on land well suited to it and properly handled will furnish fresh feed for four dairy cows for seven months each year. For the best quality of pasture the grass should not be allowed to make excessive growth and get old or tough. It is one of the earliest grasses to begin growth in the spring and will withstand pasturing well if not grazed too closely or too long continuously. Reasonably close grazing improves the quality of the pasture. (Fig. 3.)

Rotation pasturing is practiced by the more successful livestock men. This results in better utilization and a better quality of pasturage. Rotation grazing makes it possible also to use parts of the pasture for hay or seed production, if conditions are such that all of the areas can not be pastured economically.

During late spring overflows this grass will grow in the water. Some farmers pasture it under these conditions. This is not desirable; it is detrimental to the soil and injurious to the grass.

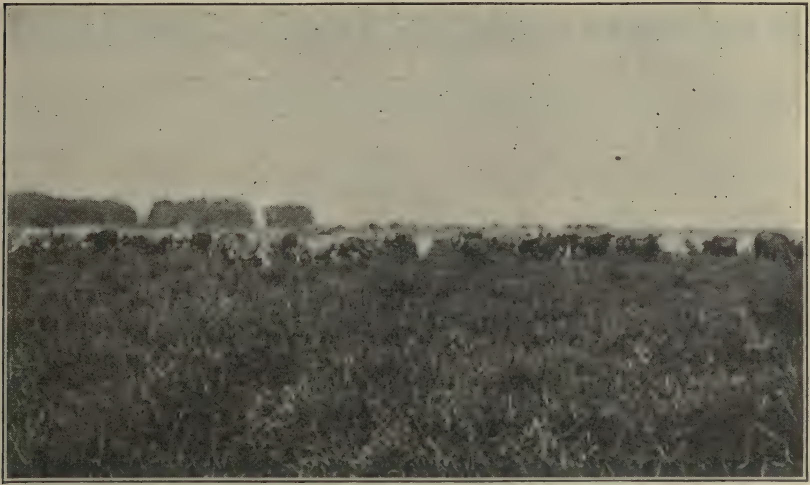

FIGURE 3.—Dairy cattle pasturing reed canary grass on the Pacific coast. Note the heavy, bunchy growth of the grass

METHODS OF HAYMAKING

The use of reed canary grass for hay is increasing. During its early history it was considered of little value for hay because of coarseness, low palatability, and the large proportion wasted by livestock. These deficiencies were mostly the results of lack of knowledge regarding the proper methods of handling.

The best quality of reed canary grass hay is obtained from thick stands pastured early in the season to retard the haymaking period and to produce leafier crowns and stems. The early season growth is usually very heavy and the stems coarse. During seasons of excessive late spring rains considerable lodging may take place.

Reed canary grass should be cut for hay when approximately 25 per cent of the early heads are in the blooming stage. It has a long heading season, and if the cutting time is delayed until the late heads are in bloom the hay is coarse and stemmy.

The hay cures rather slowly on fertile, moist lands because the large stalks settle rather closely to the ground after cutting. Tedders are effective and often used to accelerate the curing of such heavy crops. On higher, drier land, curing is more rapid because of lighter crops and drier soil.

Reed canary grass hay is nearly always shocked and allowed to remain until well cured. It is dangerous to stack or mow this hay until it is thoroughly cured, because it heats very easily and rapidly, and loss by fire or decay may result.

YIELDS AND QUALITY OF HAY

Yields of 4 to 9 tons of field-cured hay to the acre are obtained. In some sections where limited pasturing is practiced two cuttings a year are possible. Reed canary grass is not a high-class hay grass generally, but its suitability to wet and overflowed lands makes it a valuable hay grass on such soils. On account of the high yields per acre the use of reed canary grass for hay is considered profitable under such conditions, even though the palatability and nutritive value are not so high as in some other grasses. When it is fed to dairy cattle, beef cattle, or sheep, a grain ration with a small addition of some concentrate such as linseed, soybean, or cottonseed meal results in more profitable use of the hay. Livestock men consider the hay alone a good maintenance feed for wintering cattle. Large quantities are made available to the animals because there is usually some waste. This is especially true with late-cut plants when the stems are large and hard and the curing is done under unfavorable conditions. Recent seed-production practices have resulted in the cutting of the grass after the seed has been harvested. The hay made under such conditions is sometimes quite ripe and harsh. (Fig. 4.)

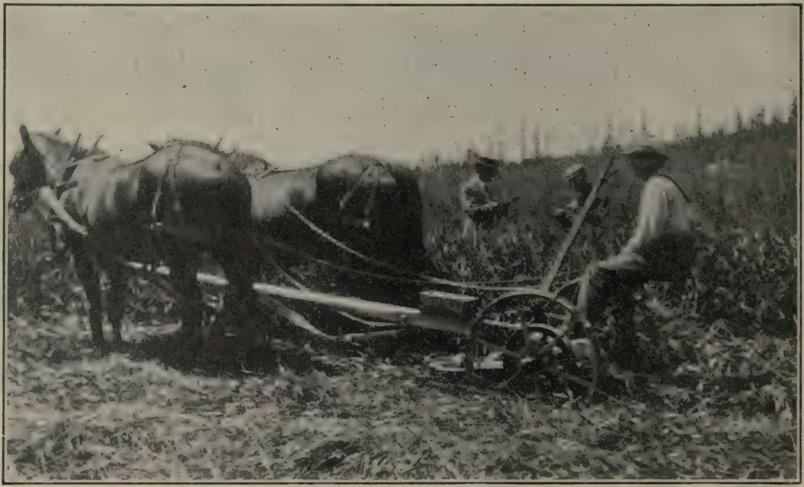

FIGURE 4.—Cutting reed canary grass for hay after the seed has been harvested

SILAGE AND SOILING VALUE

Reed canary grass is being used in increasing quantities for silage. Prepared as silage, it is a palatable, nutritious feed. The yield is large, ranging from 15 to 25 tons to the acre. Its use for silage makes possible a cheap succulent winter feed in sections where other silage crops often do not grow well or are too expensive to use profitably. The silo is a means of saving the grass when it is difficult or impossible to cure it for hay. The making of reed canary grass silage is most common at present in the Coos Bay section of Oregon. It is being fed to beef and dairy cattle with good results.

Only small quantities of reed canary grass are now used for soiling. Where very intensive livestock feeding is practiced, this grass may be so used, but its best use is as pasturage.

CHEMICAL COMPOSITION

Comparative analyses of reed canary grass forage with other forages as shown above indicate that as fresh feed it is practically equal to timothy and redtop and considerably better than winter oats. (Table 1.) As hay it has a lower feeding value than the other crops. As silage it compares very favorably with winter oats, corn, or vetch and oats.

TABLE 1.—*Comparative analyses of reed canary grass and other forage crops*

Forage	Constituents (per cent)					
	Dry matter	Ash	Crude protein	Crude fiber	Fat	Other carbohydrates
Reed canary grass, fresh	37.00	2.90	3.60	10.90	1.10	18.50
Timothy, fresh	37.50	2.20	3.10	11.70	1.20	19.30
Redtop, fresh	39.30	2.70	3.10	12.20	1.10	20.20
Winter oats, fresh	26.10	2.10	3.20	7.80	1.10	11.90
Alsike clover, fresh	24.30	2.40	4.10	6.50	.60	10.70
Reed canary grass hay [1]	92.88	4.79	4.85	27.20	1.06	54.98
Timothy hay	88.40	4.90	6.20	29.80	2.50	45.00
Redtop hay	90.20	6.80	7.40	28.70	2.30	45.00
Winter oat hay	88.00	6.80	8.40	28.30	2.80	41.70
Alsike-clover hay	87.70	8.30	12.80	25.70	2.50	38.40
Reed canary grass silage [1]	30.49	1.97	1.48	11.16	.58	15.30
Winter-oat silage	28.30	1.90	2.00	9.80	1.30	13.30
Corn silage	26.30	1.70	2.10	6.30	.80	15.40
Vetch and oats silage [1]	26.42	1.92	2.14	8.85	.60	12.91

[1] Analyses by J. S. Jones and D. E. Bullis, Oregon Agricultural Experiment Station; all others by the following: HENRY, W. A., and MORRISON, F. B. FEEDS AND FEEDING, A HANDBOOK FOR THE STUDENT AND STOCKMAN. Ed. 18, pp. 709–721, illus. Madison, Wis. 1922.

The exceedingly heavy yields and high palatability in many cases offset the differences in nutritive value when considered on the basis of the cost per ton of feed.

SEED PRODUCTION

Seed production of reed canary grass is developing rapidly along the Pacific coast, mainly in Coos County, Oreg. Until five years ago most of the seed handled by dealers was imported from Europe. Present production in commercial quantities on the Pacific coast is now supplying the demand in this country to a considerable extent. In western Oregon seed matures in late July and early August if the grass has not been pastured late or cut previously for hay.

Most of the seed is harvested by hand. The heads are cut off near the base or stripped, put in tight cloth bags, and taken to curing racks or buildings for drying. During bright warm weather outside curing racks are used. These consist of a series of two or three shelves made of fine poultry netting and arranged one above another. The ground underneath is covered by canvas to catch shattering seed. The newly harvested heads are spread on the racks to dry, and an occasional stirring causes more rapid drying. As soon as it is dry the seed is threshed out with a flail or a fork and cleaned. Barn floors are often used for drying, and although it usually takes longer to complete the process the probable loss by rain is eliminated. (Fig. 5.)

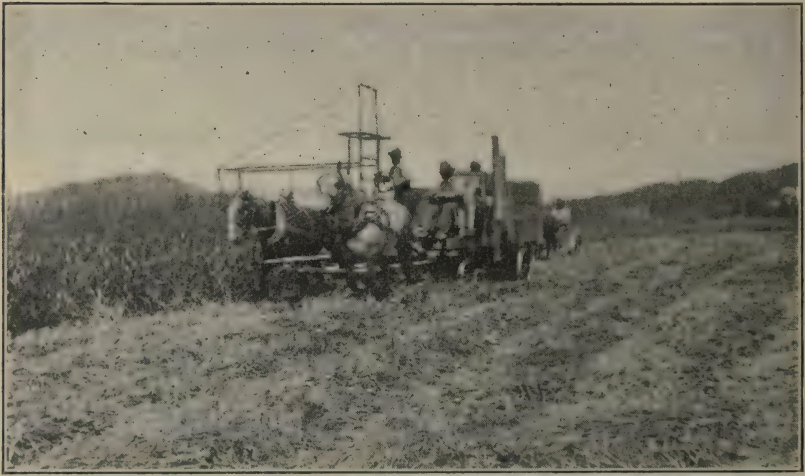

FIGURE 5.—A homemade machine harvesting reed canary grass seed

A seed harvester, a machine resembling a header, has been used to some extent in Coos County, Oreg. The heads are cut off with as little of the stem and leaves as possible, conveyed to baskets, and taken to drying racks or sheds. Underneath the conveyors and behind the sickle are screens and pans to catch as much as possible of the seed that shatters during cutting. Another method used during recent years is to ride through the fields on horseback cutting the heads and putting them into baskets attached to the saddle. In hand cutting, shears, sheep shears, or small sickles are usually used.

The yield of seed is very variable, running from 30 to 150 pounds to the acre. The average person in a good field will harvest from 20 to 40 pounds of seed per day by hand.

Largely because of harvesting expense and rather limited markets, the seed is expensive, present prices ranging from $1 to $1.50 a pound. There are apparently several strains of the ordinary reed canary grass. A number of experiment stations are working on the problem of obtaining nonshattering types. If this work is successful, it should result in lower prices for seed and a more general use of the grass.

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PLANTING AND CARE OF SHELTER BELTS ON THE NORTHERN GREAT PLAINS

By Robert Wilson, *Associate Arboriculturist, Office of Dry-Land Agriculture, Bureau of Plant Industry*

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INTRODUCTION

THE PURPOSE of this bulletin is to describe methods of planting and caring for trees in shelter belts on the northern Great Plains that have been found successful by the United States Department of Agriculture. These methods have been worked out by the Northern Great Plains Field Station, Mandan, N. Dak., through investigations conducted in the Plains section of North Dakota, South Dakota, Montana, and Wyoming.

To show the possibilities of tree planting in this area, a cooperative shelter-belt demonstration project was started in 1916. The main objects of the project have been to stimulate interest in the improvement of farm homes by the planting of belts of trees near the farm buildings and to determine by actual trial the kinds of trees best suited to the different sections and the best methods of handling them. A limited number of farmers each year have been supplied with trees to be planted and cared for in accordance with plans and instructions furnished by the Department of Agriculture. At the end of 1928 nearly 2,000 shelter belts, varying in age from 1 to 13 years, had been established. The methods described in this bulletin are based on studies of this large number of farm plantings at different periods of their growth.

The important items to be considered by the prospective tree planter are as follows: (1) The plan of the shelter belt, (2) the preparation of the soil before planting, (3) the method of planting the trees, and (4) the cultivation and protection of the trees after planting.

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SHELTER-BELT PLANS

Before a detailed plan for a shelter belt can be made, it is necessary to decide on the location and size of the planting site, the spacing distances to be used in setting out the trees, and the kinds and sizes of trees to be planted. Figure 1 shows a typical shelter-belt plan embodying the principles set forth in the following paragraphs. This plan must ordinarily be modified in details to fit the actual conditions existing on a given farm.

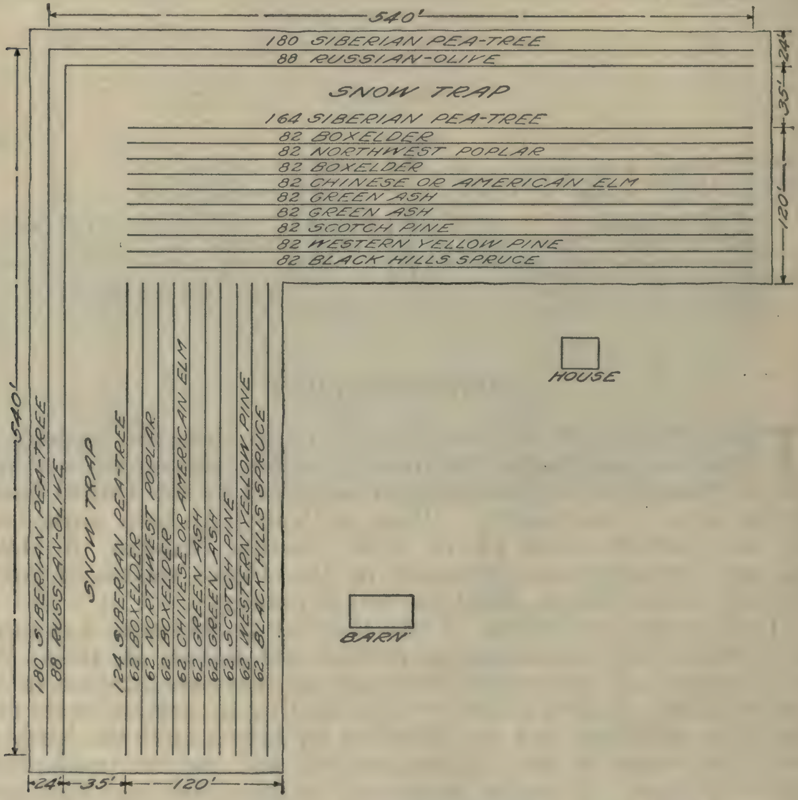

FIGURE 1.—Typical shelter-belt planting plan. Rows 12 feet apart. Siberian pea-trees 3 feet apart in the row; all other species 6 feet apart in the row. Trees required: Siberian pea-tree, 648; Russian-olive, 176; boxelder, 288; northwest poplar, 144; Chinese elm or American elm, 144; green ash, 288; Scotch pine, 144; western yellow pine, 144; and Black Hills spruce, 144

SIZE AND LOCATION OF SHELTER BELTS

SHELTER FOR BUILDINGS AND YARDS

Winter protection is the important consideration in locating a shelter belt for buildings and yards. As winter storms on the northern Great Plains usually come from a northwesterly direction, the shelter belt should be placed north and west of the buildings, so as to form a belt of uniform width in the shape of a right angle. If the buildings are so located that it is not feasible to plant trees on two sides, the shelter belt may be laid out as a single strip on either the north or the west side.

A space of 50 to 100 feet ordinarily should be allowed between buildings and the inside edge of the shelter belt.

Where sufficient land is available, the planting should be from 100 to 200 feet wide, so that it may include a snow trap, as illustrated in Figure 2. If the width of the planting is less than 100 feet, it is probably best to plant a solid belt without a snow trap.

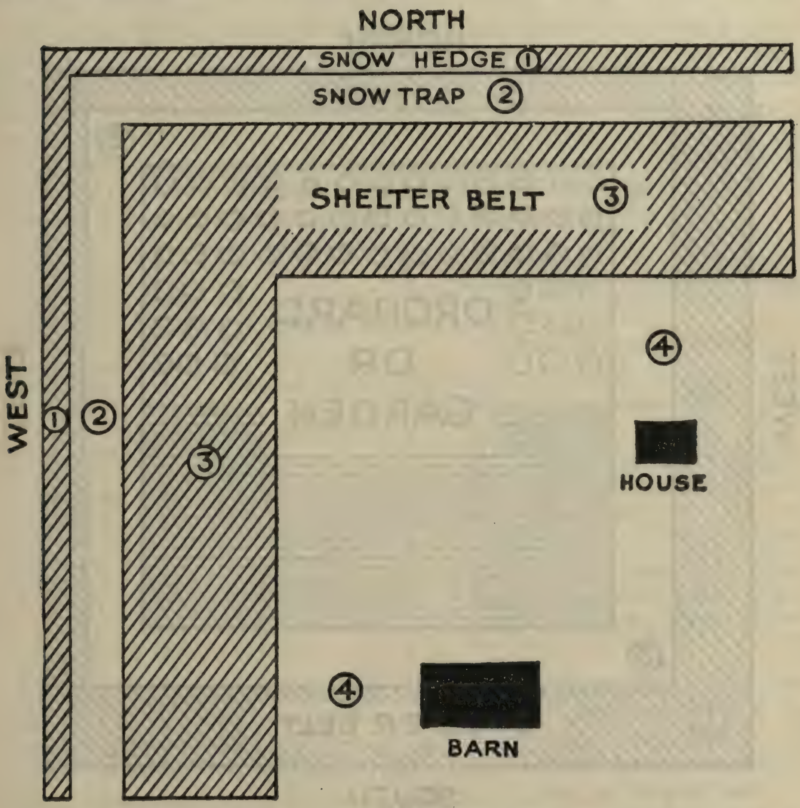

FIGURE 2.—Plan of a shelter belt recommended for buildings and yards. 1, Snow hedge, 20 to 30 feet wide; 2, snow trap, 30 to 60 feet wide; 3, shelter belt, 50 to 100 feet wide; 4, space 50 to 100 feet wide between shelter belt and buildings

SHELTER FOR ORCHARD AND GARDEN

Protection from strong winds in spring and summer is of first importance in planning the location of a shelter belt for orchard and garden. Protection is usually most needed on the west and south, although shelter on the north and east will prove of value. The width of a planting for the protection of an orchard or a garden may be somewhat less than that required for the winter protection of buildings and yards. Single rows of trees often will prove beneficial.

As trees send out their roots for some distance beyond the row in which they are actually planted, fruit trees and garden crops should not be placed closer than 20 to 30 feet from the inside row of the shelter belt. Figure 3 illustrates the location of a shelter belt for an orchard or a garden.

SPACING DISTANCES

In a region of limited rainfall, wide spacing will favor the vigor and rate of growth of the individual tree. It is obvious, however, that a shelter belt can not be fully effective in checking the wind until the branches of the trees have grown together. It therefore seems practicable to adopt a system of spacing by which the trees are planted fairly closely together in the row, with a greater space between the rows.

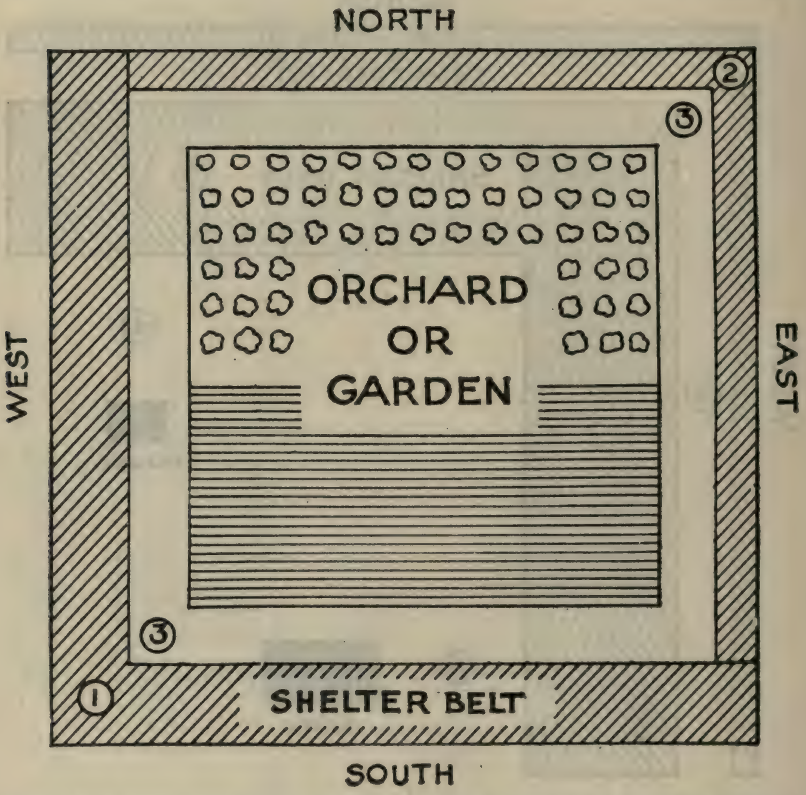

FIGURE 3.—Recommended plan of a complete shelter belt for an orchard or a garden. 1, Shelter on the west and south, of first importance; 2, shelter on the north and east, of second importance; 3, a space of at least 20 to 30 feet should be left between the shelter belt and the orchard or garden

A spacing distance of 6 by 10 or 6 by 12 feet is recommended, the rows to be 10 or 12 feet apart and the trees to stand 6 feet apart in the row. Siberian pea-tree and similar hedgelike types of trees should be spaced 3 feet apart in the row when planted on the edge of a shelter belt. Closer spacing, such as 4 by 8 or 4 by 4 feet, may be used if a dense stand is desired in the shortest possible time. Unless trees so spaced are thinned at a later date, it is not likely that they will continue in a thrifty condition for so long a period as the same kinds planted 6 by 10 or 6 by 12 feet apart.

It is especially beneficial to allow space on the outside edge of the planting for a strip of cultivated soil of the same width as the full distance between the rows of trees.

KINDS OF TREES

In selecting the trees for a shelter belt, better results are usually obtained where two or more species of trees are used in combination than where only a single species is used. For the outside rows of a shelter belt, trees that will form a dense growth close to the ground are the most desirable. For the rows in the interior of the belt, trees that attain a good height are the best type to plant. Species of trees that have been found suitable for use in shelter-belt plantings on the northern Great Plains are given in the following list:

BROADLEAF OR DECIDUOUS TREES

Suitable for outside rows:
- Siberian pea-tree (*Caragana arborescens*).
- Chokecherry (*Prunus virginiana*).
- American plum (*Prunus americana*).
- Silver buffaloberry (*Lepargyrea argentea*).

Suitable for interior rows:
- American elm (*Ulmus americana*).
- Green ash (*Fraxinus lanceolata*).
- Chinese elm (*Ulmus pumila*).
- Sargent cottonwood (*Populus sargenti*).
- Northwest poplar (*Populus sp.*).
- Boxelder (*Acer negundo*).

Suitable for interior rows—Continued.
- Russian-olive (*Elaeagnus angustifolia*).

CONIFER OR EVERGREEN TREES

Suitable for outside rows:
- Black Hills spruce (*Picea glauca-albertiana*).
- White spruce (*Picea glauca*).
- Colorado spruce (*Picea pungens*).
- Red cedar (*Juniperus virginiana*).

Suitable for interior rows:
- Western yellow pine (*Pinus ponderosa*).
- Scotch pine (*Pinus sylvestris*).
- Jack pine (*Pinus banksiana*).
- American larch (*Larix laricina*).
- European larch (*Larix decidua*).

The species given in the foregoing list are trees that have shown promise under actual test. The list does not include all the trees that might be successfully grown on the northern Great Plains. No single species of tree will be certain to grow in every location in this region, and there is considerable variation in the ability of each kind of tree to adapt itself to all the conditions of temperature, soil, drought, and exposure that exist in an area so extensive. The tree planter should be ready to replace any of the species that he may select if actual trial proves that they do not survive under his conditions.

SIZE OF PLANTING STOCK

For shelter-belt planting, younger and smaller trees than are used for ornamental or shade-tree plantings are desirable. For the broadleaf or deciduous species, seedlings 1 or 2 years old and from 1 to 2 feet high or 1-year-old rooted cuttings make the best stock. For conifer or evergreen species transplants 6 to 12 inches high should be used. The following ages and sizes are recommended for the more commonly used species:

Siberian pea-tree, green ash, and American elm, 2-year-old seedlings, 12 to 24 inches high. Boxelder and Russian-olive, 1-year-old seedlings, 12 to 24 inches high. Northwest poplar and cottonwood, 1-year-old rooted cuttings with tops cut back so as to be 6 inches high. Black Hills spruce, white spruce, and Colorado spruce, transplants, 5 or 6 years old from seed, 6 to 12 inches high. Scotch pine, jack pine, and western yellow pine, transplants, 3 or 4 years old from seed, 6 to 12 inches high.

It is advisable to procure about 10 per cent more trees of each kind than are actually needed to make the planting. The extra trees will allow for discarding any injured or undersized ones and will provide a small stock that can be temporarily planted in a garden or other suitable piece of ground and be used to replace losses in the permanent planting the first year.

PREPARATION OF LAND FOR TREES

Under Great Plains conditions, trees have a fair chance of success only when planted in moist soil that is free from sod and weeds. The best tillage method to put land in this condition is summer fallow. Land on which a shelter belt is to be planted should, therefore, be summer fallowed the year before the trees are to be set out. If land is in sod it may take two years of summer fallow to put it into suitable condition.

The purposes of summer fallowing land in preparation for tree planting are (1) to work down the soil into a smooth, firm condition and to kill out all grass and weeds and (2) to keep the surface of the soil in a rough or ridged condition so that it may readily absorb as much as possible of the season's rainfall.

RULES FOR SUMMER FALLOW

Plow the land in the spring to a depth of 6 to 8 inches. This should be done not later than the first of June. As soon as the plowing is completed go over the ground once or twice with a harrow.

Cultivate the land as often as necessary during the summer to keep it free from weeds. It may also be advisable to cultivate after each extremely heavy rainfall that leaves the surface in a hard, packed condition.

Use a shovel or duck-foot type of cultivator in preference to a disk or harrow for working the land during the summer. The shovel type of implement leaves the surface in the best condition for soaking up rainfall and preventing soil blowing.

Give the land one cultivation in the late fall to destroy late weeds and leave the surface in a rough or ridged condition over the winter. Do not plow the land in the spring before planting, as a firm, well-settled soil is desirable for planting trees.

FENCING

Before the trees are planted, a fence that will keep out all classes of livestock should be provided. Rabbit-proof woven wire makes the best type of fence for this purpose.

METHODS OF PLANTING TREES

TIME OF PLANTING

Tree planting in the Great Plains area should be done in the spring. The planting season begins as soon as the frost is out of the ground and usually lasts for about four weeks.

Fall planting of trees is a successful practice in many regions, but on the Great Plains the fall season usually is dry, and the soil is subjected to a certain amount of heaving and cracking during the winter. This makes the fall season a much less favorable time than the spring for planting small trees.

If trees are received from the nursery in the fall, they should be carefully heeled in and not planted until spring.

CARE OF TREES BEFORE PLANTING

WETTING DOWN AND TEMPORARY STORAGE

Although trees that are obtained from a nursery are usually packed so that they will keep in the bundle for a period of a week to 10 days, they should be taken to the farm and unpacked as soon as possible. Unwrap the shipment in some cool, protected place and thoroughly wet the roots. If planting is to start at once, the trees may be kept for a short time by wetting down the packing material and repacking it about the roots. A cool cellar or barn is a suitable place to keep trees stored in this way. If the trees must be kept for a week or more, they should be heeled in.

HEELING IN

To heel in trees, dig a trench the width of an ordinary plow furrow and about a foot deep, with one side sloping. The dirt from the trench may be placed along the sloping side to increase its height. Lay the trees against the sloping side, roots resting in the bottom of the trench, tops pointing up the slope, as shown in Figure 4. Fill dirt against the trees so as to cover completely the roots and a portion of the tops, packing it well. Small bunches of trees that can easily be held in one hand may be heeled in without being opened. If the trees come tied in large bundles, these should be cut open so that they may be spread out to allow the soil to pack more closely about each tree. If the soil is at all dry it should be well soaked with water after the heeling in is completed.

Trees will keep better if heeled in in a cool, shaded location than if placed where they will be exposed to the warm rays of the sun. It should be remembered that heeling in is a method of temporary storage. When the trees show signs of starting to send out leaves they must be planted without delay.

PLANTING THE TREES

Trees should be planted as soon as possible after being received. Endeavor to have the planting completed before they show any signs of starting to send out leaves.

The position of the rows as given in the planting plan should first be marked on the ground. Set stakes, stretch a string, or use any other practical method that will insure straight, accurately spaced rows. The principal implement for planting trees of the size recommended is the spade. Some persons use only a spade or a shovel for digging the holes. Others first plow a deep furrow the length of the row and deepen or enlarge it with a spade or a shovel at the points where the trees are to be set. The furrows are filled in after the planting has been completed. Whatever method is used for digging the holes, the following fundamental principles should be observed: (1) Keep the roots of the trees moist by carrying them in a pail of water or wrapped in a wet sack; (2) make the holes wide and deep enough to allow the roots to be spread naturally; (3) set the tree a little deeper than it stood in the nursery; (4) pack the soil firmly about the roots. Firming the soil should begin when the hole is partly filled and should continue until the filling is completed. When a tree is properly planted it should not be possible to move it with a fairly strong pull of the hand. Correct and incorrect planting practices are shown in Figure 5.

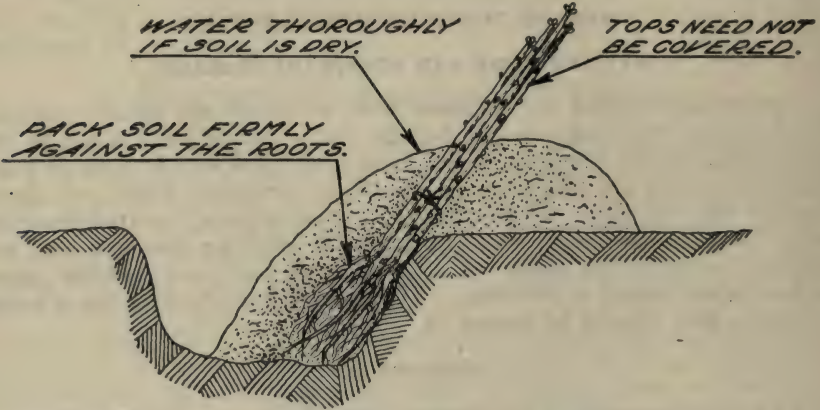
WATER THOROUGHLY IF SOIL IS DRY.
TOPS NEED NOT BE COVERED.
PACK SOIL FIRMLY AGAINST THE ROOTS.

FIGURE 4.—Heeling in small bunch of trees

CULTIVATION AND PROTECTION OF TREES AFTER PLANTING

CULTIVATION

Control of weeds is the primary problem in the care of trees on the Great Plains. The most important operation in this connection is clean cultivation. Grass and weeds are perhaps the worst enemies of young trees, so cultivation should be practiced for several years, or as long as it is possible to work between the trees. Cultivation can be done for the most part with horse-drawn implements, but when the trees are very small weeds that are missed by the horse-drawn cultivator should be taken out with a hoe. If summer fallow has been effectively carried out so that the soil is free from weeds at the time of planting, the minimum amount of labor will be needed to keep the shelter belt clean.

The mulching of trees with straw or manure as a substitute for cultivation has been tested, but the results do not warrant the recommendation of this practice. In addition to the fact that mulching gives little evidence of beneficial effects, certain harmful conditions have been observed, such as furnishing harbors for mice, introducing weed seeds, increasing the fire danger, and preventing light rainfall from reaching the soil.

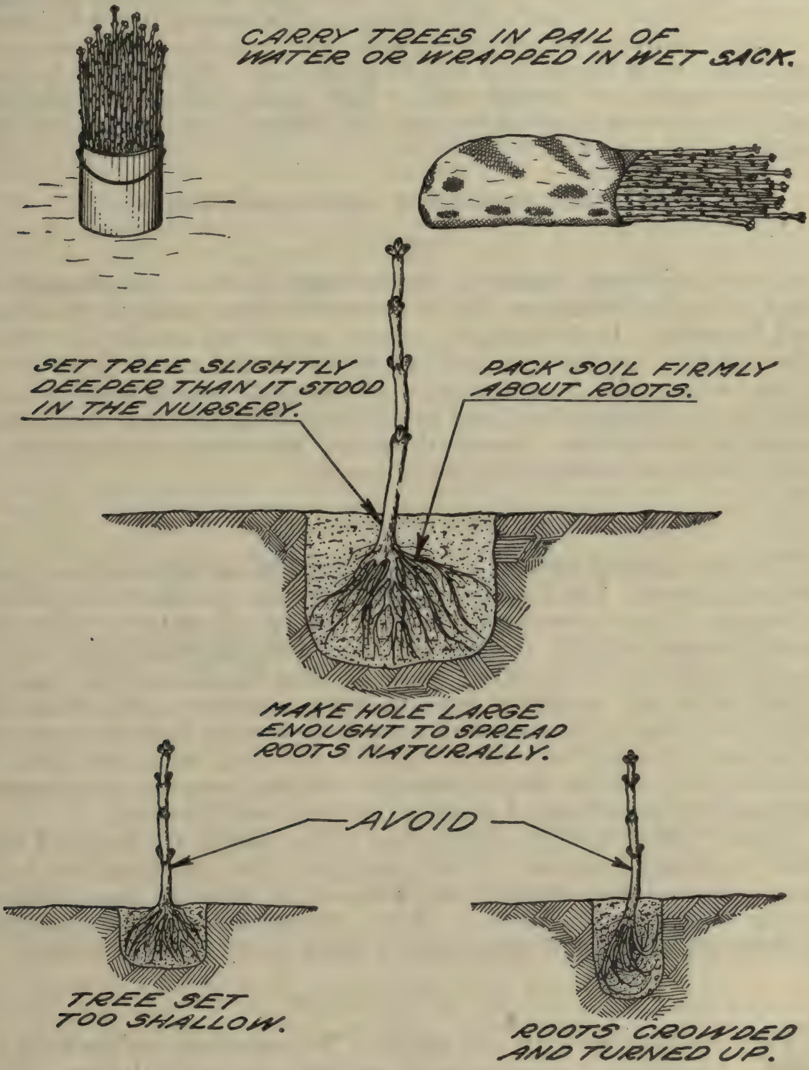
CARRY TREES IN PAIL OF WATER OR WRAPPED IN WET SACK.
SET TREE SLIGHTLY DEEPER THAN IT STOOD IN THE NURSERY.
PACK SOIL FIRMLY ABOUT ROOTS.
MAKE HOLE LARGE ENOUGHT TO SPREAD ROOTS NATURALLY.
AVOID
TREE SET TOO SHALLOW.
ROOTS CROWDED AND TURNED UP.

FIGURE 5.—Correct and incorrect practices in planting trees

PRUNING

Pruning has a limited application to the shelter belt, but unless it is done intelligently it is probably best to do no pruning whatever. The practice of trimming the branches to a height of 5 or 6 feet is distinctly detrimental. The beneficial effects of pruning are confined to such early trimming out of branches close to the ground as will assure to the tree a single central trunk. The need for this type of pruning will vary with the different species of trees.

With such trees as Siberian pea-tree in the outside row, branching close to the ground is desirable, and the tops should be cut back to encourage this type of growth. It may also be desirable to allow the development of low side branches in the second and third rows. For the remainder of the shelter belt, side branches which come out within a foot of the ground may be pruned off. This should be done during the first and second years. Care should be taken to have the knife or pruning shears sharp and the branches cut off clean so that no short stubs are left.

CONTROL OF INSECT AND ANIMAL PESTS

INSECTS

Several different forms of insects cause more or less damage to trees either by feeding on the leaves or by boring holes in the trunk and branches. Leaf-damaging insects are of two kinds: (1) Those that actually eat the leaf, such as blister beetles and a large green worm occasionally found on boxelder; and (2) insects such as plant lice and leaf curlers that feed by sucking the juices from leaves and tender growing tips. Insects damaging the trunks or branches of trees are classed under the name of borers.

LEAF-EATING INSECTS

The best general method of control for leaf-eating insects is lead-arsenate spray. Use 1 pound of lead arsenate powder to 50 gallons of water (3 level teaspoonfuls to 1 gallon of water). Mix just enough water with the powder to form a thin paste and then add to the full quantity of water required, churning the mixture thoroughly. Apply with any available type of orchard sprayer. For trees less than 5 or 6 feet in height a compressed-air sprayer having a capacity of about 3 gallons, or a barrel sprayer mounted on a cart, sled, or wheelbarrow, will be found suitable. As lead arsenate is a poison, it should be stored out of reach of children and livestock.

Hand picking will prove effective if the insects are few and confined to a small section of the planting. For checking the large green worms found working on the leaves of boxelder hand picking is the only effective method. These worms are quickly destroyed if dropped into a pail containing a small quantity of kerosene.

LEAF-SUCKING INSECTS

Lead-arsenate spray is not effective in combating leaf-sucking insects. An effective material is 40 per cent nicotine sulphate. This liquid should be mixed with water at the rate of one-half pint (1 cup) to 50 gallons of water (3 teaspoonfuls to 3 gallons of water). Add two or three bars of soap previously dissolved in water to the 50-gallon mixture, or 3 ounces to the 3-gallon mixture, and apply with an orchard sprayer.

BORERS

Borers can not be controlled by spraying. Sound trees are less liable to attack than injured trees. For this reason, if borers are found working on any species of tree, the spread of the infestation may be checked by trimming smoothly all scars or wounds and painting the exposed wood with any good waterproof paint.

RODENTS

Jack rabbits, field mice, and pocket gophers may cause serious damage to shelter-belt plantings on the northern Great Plains. An effective protection against jack rabbits, which have been the most destructive in the cooperative plantings, is a rabbit-proof woven-wire fence. Encircling the bases of trees with woven wire of ¼-inch mesh or with some similar form of guard is an effective means of protection against mice, but is more practicable in orchards than in shelter belts. Directions for destroying these rodents as furnished by the Bureau of Biological Survey are as follows:

JACK RABBITS

Poisoned alfalfa leaves.—Dissolve 1 ounce of strychnine sulphate in 2 gallons of hot water and sprinkle over 12 pounds of clean alfalfa hay leaves. Mix the poisoned leaves thoroughly until all moisture is absorbed. Should strychnine alkaloid be used, 1 quart of vinegar should be substituted for 1 quart of water in preparing the solution, and equally good results will be obtained.

Poisoned oats.—Mix 1 tablespoonful of starch in one-half cup of cold water and stir into 1 pint of boiling water to make a thin clear paste. Mix 1 ounce of powdered strychnine with 1 ounce of powdered bicarbonate of soda (baking soda) and stir with the starch to a smooth creamy mass. Stir in 1 teacup of table salt. Apply to 12 quarts of good clean oats and mix thoroughly to coat each kernel. Each quart should make from 25 to 30 baits.

The poisoned baits should be distributed in the evening by placing small handfuls in lines a few feet apart along the rabbit runways. If all baits remaining uneaten are removed the following morning, there will be less danger of poisoning domestic livestock.

FIELD MICE

Starch-coated grain bait.—Mix 1 tablespoonful of gloss starch in one-half teacup of cold water and stir into three-fourths pint of boiling water to make a thin clear paste. Mix 1 ounce of powdered strychnine with 1 ounce of baking soda and stir into the starch to a smooth creamy mass free of lumps. Stir in one-fourth pint of heavy corn sirup and 1 tablespoonful of glycerine. Apply to 12 quarts of wheat or to 20 quarts of steam-crushed whole oats and mix thoroughly to coat each kernel.

Steam-crushed whole oats are preferable, as they may be distributed promiscuously over the infested area without endangering bird life. The poisoned bait should be scattered along runways and within entrances of burrows, a teaspoonful at a place. Wheat, however, in order not to endanger birds, should be placed inside the mouse tunnel openings, under dense cover, or in poison stations.

POCKET GOPHERS

Pocket gophers are readily caught in any one of several makes of special traps commonly on the market. For ridding alfalfa fields, orchards, and long stretches of ditch embankments of them, a very successful and much more practical method is to poison them by use of baits of vegetables, or by using poisoned grain. Either the vegetable or the grain bait gives excellent results, but about one pocket gopher out of ten will not eat a poisoned bait, and these individuals must be trapped.

Vegetable baits.—Cut carrots, sweet potatoes, or parsnips into pieces about 2 inches long and one-half inch square, and wash and drain. From a pepper box slowly sift one-eighth ounce of powdered strychnine (alkaloid) and one-tenth ounce of saccharin (ground together in a mortar) over about 4 quarts of the dampened baits, stirring to distribute the poison evenly.

Grain baits.—Dissolve 1 heaping teaspoonful of dry gloss starch in a little cold water and add to three-fourths pint of hot water. Boil, stirring constantly until a thin clear paste is formed. Mix together 1 ounce of powdered strychnine (alkaloid) and 1 ounce of baking soda, sift into the hot starch paste, and stir thoroughly to a smooth creamy mass. Add one-fourth pint corn sirup, 1 tablespoonful glycerine, and one-tenth ounce saccharin, and stir well. Pour this mixture over 13 quarts of oats, rolled barley, milo, or feterita, and mix thoroughly so that each kernel is evenly coated. Allow it to dry before it is used. (It is important that only the best grade of thoroughly clean grain be used, as chaff absorbs and wastes much valuable strychnine, and poisoned weed seeds imperil useful bird life.)

The runways, which are usually 4 to 8 inches beneath the surface, can be located by means of a probe made of any strong handle 1 inch in diameter and 36 inches long. One end should be bluntly pointed. Into the other end should be fitted a piece of ¼-inch iron rod, protruding about 15 inches and bluntly pointed. A foot rest aids in probing hard soils. By forcing down the iron rod near pocket-gopher workings, or a foot or two back of fresh mounds, the open tunnel can be felt as the point breaks into it. The blunt end of the instrument is then used carefully to enlarge the hole, and a vegetable bait or two, or a tablespoonful of grain bait, is dropped into the run, and the probe hole closed. If a shovel is used instead of a probe to locate the runways, care should be taken not to disturb the runway more than necessary. Close the hole made so as to keep out the light, taking care that loose dirt does not fall upon the baits placed in the runway.

DOMESTIC LIVESTOCK

Horses, cattle, sheep, and hogs may do great damage to a planting of trees and should be kept out of the shelter belt by a stock-tight fence.

Should any serious infestation of insect or other pests occur, it is well to consult the State agricultural college or the United States Department of Agriculture for specific recommendations for control.

SUMMARY

The first step in establishing a shelter-belt planting is to make a drawing or planting plan showing details of the proposed planting.

Shelter for buildings and yards should be placed with the idea of winter protection. Shelter for orchards and gardens should be placed in the path of strong spring and summer winds; winter protection is of secondary importance.

Trees in a shelter belt may be placed from 4 to 6 feet apart in the row, and the rows should be from 8 to 12 feet apart. Caragana and other hedgelike types of trees should be spaced 3 feet apart in the row when planted on the edge of a shelter belt.

Two or more kinds of trees in combination give better results than the planting of only one kind. Green ash, American elm, boxelder, Siberian pea-tree, Albertiana or Black Hills spruce, and western yellow pine are some of the important species for planting on the northern Great Plains.

Well-grown seedlings 1 or 2 years old and 12 to 24 inches high are the best size of planting stock of the broadleaf types of trees. For evergreen stock transplants 6 to 12 inches high should be used.

Preparation of the soil before planting is necessary to eliminate grass and weeds and to store moisture in the soil. Clean summer fallow is the best tillage method to prepare land for tree planting.

Plant trees in the spring. Set them so that none of the root area is exposed, and pack the soil firmly about the roots. Protect the roots from drying during the planting operation.

Cultivation should be continuous during the early age of a planting, or as long as horse-drawn implements can be driven between the rows. Mulching with straw or manure is not a satisfactory substitute for clean cultivation.

It is permissible to prune off side branches near the ground, but to trim off the branches to a height of 5 or 6 feet is decidedly detrimental to a shelter-belt planting.

Tree plantings should be fenced to exclude domestic livestock. Woven wire that will keep out rabbits is the best type of fence. Trees also require protection from damage by insects and fire.

A strip of ground the full width of the distance between the rows should be cultivated along the edges of the planting.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

August 5, 1929

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DAIRY-HERD-IMPROVEMENT ASSOCIATIONS, AND STORIES THE RECORDS TELL

By J. C. McDowell, *Senior Dairy Husbandman, Bureau of Dairy Industry*

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LIKE A SEARCHLIGHT, the dairy-herd-improvement association pierces the dense darkness that prevails so generally regarding the records of our dairy cows. In this penetrating and revealing light, production and feed-cost records stand out clearly. Only the scrub cow whose milk or butterfat production is scant need fear the light. Well may that cow dread the truth as told by the milk scales and the Babcock test, because when her record becomes known her doom is sealed and she must depart forever from the herd.

Far different is the fate of the large producer. She has no cause to fear the light. Through the work of the dairy-herd-improvement association her high record stands out as it actually is, her true value becomes known, and in the dairy herd she takes her proper place. From that time on, if she is fed according to production, she will produce milk abundantly. As the years roll around she may become the mother of a strain of high producers and persistent milkers, and unlike her distant relative, the scrub, she may remain for many years an honored member of the dairy herd—honored because profitable.

METHODS OF WORK

As ordinarily conducted in this country, a dairy-herd-improvement association is an organization of about 26 dairy farmers, who cooperatively employ a tester to keep production, feed, and income records of their dairy cows.[1] Knowing the actual records of his cows, the dairyman can with certainty eliminate those that are unprofitable and feed the remainder according to known production.

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[1] The following publication, giving details regarding the tester's work, may be obtained on application to the department: McDowell, J. C. THE COW TESTER'S HANDBOOK. U. S. Dept. Agr. Misc. Circ. 26, 24 p., illus. 1927.

The most useful dairy-herd-improvement association also compares the records of dams and daughters, promotes the use and ownership of better sires, especially good proved sires, and shows the advantage of feeding satisfactory rations. This is a big program, but it is not too big for the well-organized and well-managed association.

ACCURACY OF DAIRY-HERD-IMPROVEMENT ASSOCIATION METHOD

In the dairy-herd-improvement association work the milk is ordinarily weighed and tested one day each month, and the monthly production is determined by multiplying the daily production by the number of days in the testing period. (Fig. 1.)

To determine the accuracy of this method of calculating production, the United States Department of Agriculture has compared results of this method with a large number of yearly individual-cow records of the Minnesota Experiment Station which gave the production of milk and butterfat for each milking throughout the year. By systematically picking out the weights and tests for one day each month, as they would have been obtained by the association method, and thus calculating the yearly production, it was found that the association method was accurate within 2 per cent on milk production and within 3 per cent on production of butterfat.

FIGURE 1.—The milk is tested once a month and the results recorded

A tabulation has also been made of a large number of yearly individual-cow records from the Bureau of Dairy Industry experimental farm at Beltsville, Md. These records gave the milk production night and morning for every day in the year. A yearly total calculated from one day's record each month, when compared with the actual milk production, showed an accuracy within 1.99 per cent. These comparisons indicate that the method used in association work gives a reasonably accurate record of production.

INCREASE IN NUMBER OF DAIRY-HERD-IMPROVEMENT ASSOCIATIONS

The first dairy-herd-improvement association in the United States was organized in Newaygo County, Mich., in 1905, and the testing work was begun in January, 1906. Since then, with the exception of the two years, 1918 and 1921, there has been a rapid and fairly constant growth in the number of associations. Table 1 shows the number of associations on July 1 of each year from 1906 to 1923, inclusive, and on January 1 of each year since 1925. Figure 2 shows graphically how the number of these associations has increased during these years.

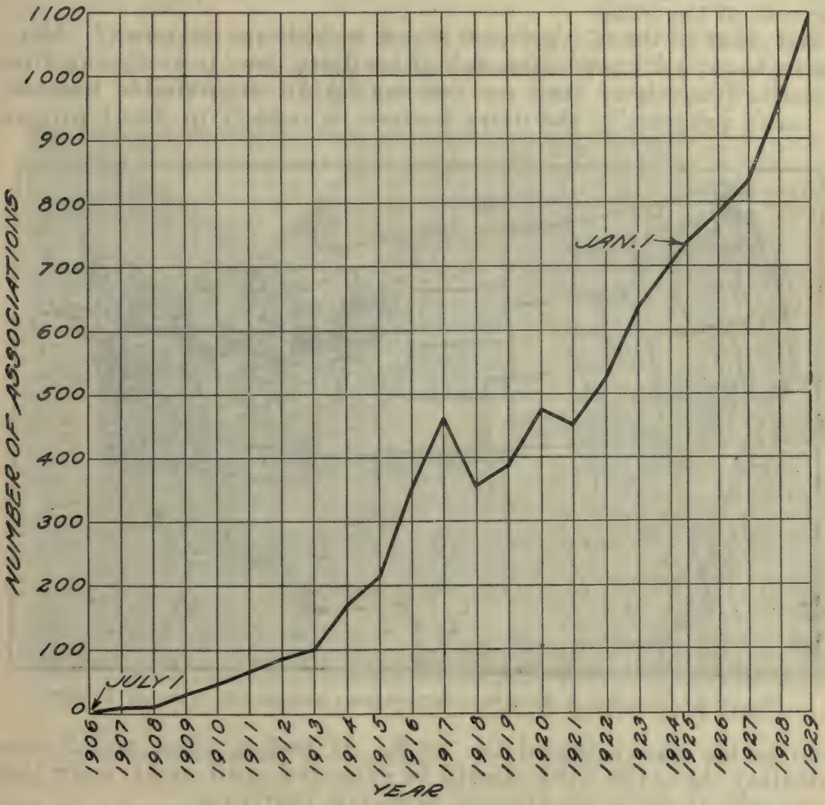

FIGURE 2.—How dairy-herd-improvement associations have grown in numbers year by year

TABLE 1.—*Number of dairy-herd-improvement associations, 1906 to 1929, inclusive*

Year	Associations	Year	Associations	Year	Associations
1906	1	1914	163	1922	513
1907	4	1915	211	1923	627
1908	6	1916	346	1925	732
1909	25	1917	459	1926	777
1910	40	1918	353	1927	837
1911	64	1919	385	1928	947
1912	82	1920	468	1929	1,090
1913	100	1921	452		

The decline in this work in 1918 and again in 1921 was due largely to a shortage of trained testers. The number of associations in active operation January 1, 1929, was 143 more than on January 1, 1928. Figure 3 shows the distribution of the associations on January 1, 1929.

On January 1, 1929, there were 1,090 associations with 26,182 members and 465,804 cows on test. As there are approximately 21,948,000 dairy cows on farms in the United States, the number of cows now on test in dairy-herd-improvement associations is approximately 2.1 per cent of the total.

But what of the 97.9 per cent whose records are unknown? Many men who do not know what each of his dairy cows is producing from a dollar's worth of feed are conducting an unprofitable business. A man's progress in the dairy business is usually in direct proportion to his knowledge of the work. If testing pays, and it most certainly does, the work should be extended until many more than 2 per cent of our dairy cows are placed on yearly test.

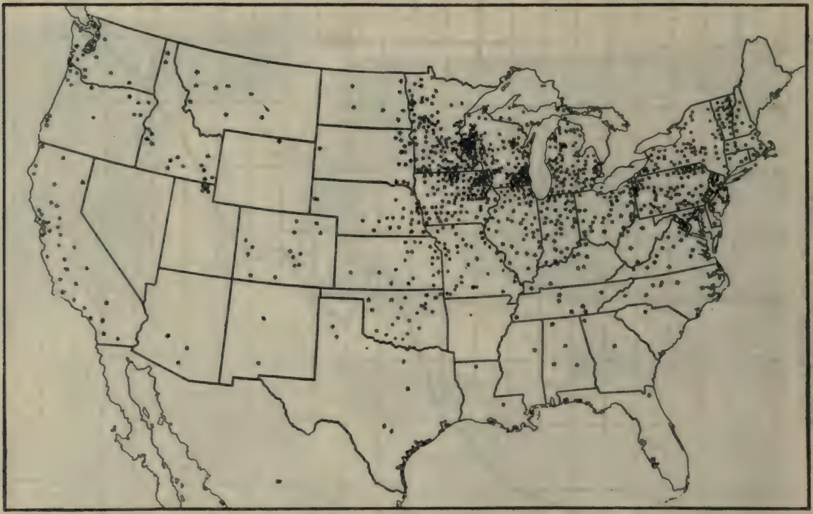

FIGURE 3.—Location of dairy-herd-improvement associations, January 1, 1929

RESULTS OF DAIRY-HERD-IMPROVEMENT ASSOCIATIONS

FIVE YEARS OF PROGRESS

In a well-managed dairy-herd-improvement association the gain in average production per cow is quite rapid during the first four or five years of association work. In the case of three typical associations—one in Michigan, one in Ohio, and one in Pennsylvania—the average production of butterfat per cow during the first five years of testing showed a gain each year in each association. For the three associations when averages were combined, the yearly butterfat production per cow was as follows: First year, 237 pounds; second year, 255 pounds; third year, 278 pounds; fourth year, 292 pounds; and fifth year, 305 pounds.

What the average butterfat production was during the year before the work began there is no means of knowing, but in many of the herds it probably was about the average production for all the dairy cows in the United States, which is estimated to be 180 pounds a year. Therefore it seems reasonable to conclude that the dairy-herd-improvement association work has added about 125 pounds to the average production of butterfat per cow in these three associations. The figures just given are normal for the well-managed association, but there are many associations where the gains from year to year are not so great.

Every association member should watch the production figures of his cows, and he should not be satisfied unless there is a rapid gain in average milk and butterfat production every year until the herd reaches a high level of production. Even then he should strive to obtain at least a small gain in production per cow from year to year.

FIGURE 4.—Scrub herd. This herd is unprofitable—and does the owner know why?

HELPS BOTH HIGH AND LOW PRODUCING HERDS

The dairy-herd-improvement association work helps both low and high producing herds. (Figs. 4 and 5.) When the first Minnesota association was started near Albert Lea in 1910 the lowest-producing herd on test consisted of 30 cows whose average production was 2,958 pounds of milk and 112 pounds of butterfat. That year the butterfat did not pay the cost of feed. Four years later there were 20 cows in the same herd; their average production was 4,759 pounds of milk and 228 pounds of butterfat, and the average income over cost of feed was $50. In four years' time the average butterfat production per cow in that herd was more than doubled, resulting in a substantial income over cost of feed.

The first year the highest-producing herd in that association consisted of 22 cows whose average production was 9,390 pounds of milk and 311 pounds of butterfat, and the average income over cost of feed was $52. Four years later the same herd consisted of 25 cows whose average production was 11,948 pounds of milk and 400 pounds of butterfat, and the average income over cost of feed was $98. Here is a gain in yearly production of butterfat per cow of more than 28 per cent, and the income over cost of feed was almost doubled.

These figures show that the work of the dairy-herd-improvement association improves high-producing herds as well as those of lower quality. In both cases the results were brought about through selection and breeding, better feeding, and better care.

FIGURE 5.—A high-producing group. But testing will show big differences in their records

SELLING COWS ON THEIR RECORDS

Reliable production records help in the sale of good stock. Buyers usually want to know how much milk a cow gives. The dairy-herd-improvement association records not only tell this, but they show her butterfat production and the amount of feed she ate while making the record. Anyone would pay more for an animal whose yearly production record shows 10,000 pounds of milk containing 450 pounds of butterfat than if nothing definite were known about her.

At public sales dairy-herd-improvement association records have sometimes greatly raised the prices received for cows. Association sales may be arranged in some cases to advantage. When a sale can be arranged among a number of neighboring farmers it is possible to attract more buyers and thus obtain for the cattle a price nearer their actual value. Such a sale has an advantage to the buyer also, because he knows where to find the stock that is for sale and does not have to spend time and money driving from farm to farm looking for it.

HOW FARMERS REGARD THE WORK

One farmer says that at the beginning of his first year in a dairy-herd-improvement association he knew he was making no money, but he did not know why. He says that at the end of the testing year he still knew he was making no money, but by that time he knew why. He is now the owner of a high-producing and profitable dairy herd.

When another farmer joined a dairy-herd-improvement association he was the owner of 14 cows. The first year's records showed that 7 of his cows were very profitable and that 7 were decidedly unprofitable. This farmer says that his herd reminded him of the Hebrew-Egyptian story of the 7 fat years and the 7 lean years, for as the 7 lean years ate up the 7 fat years, so his 7 poor cows ate up the profits the 7 good cows made. When that farmer signed up for a second year in the association he was the owner of a smaller but better herd.

FIGURE 6.—Their records tell a pleasing story

The following quotations are from what farmers have said regarding dairy-herd-improvement association work:

> The first year I belonged to the association my herd of 10 cows produced an average of 279 pounds of butterfat, with an average income over cost of feed of $37. The fifth year my herd, which then consisted of 17 cows, produced an average of 380 pounds of butterfat with an average income over cost of feed of $82.
>
> The work of the dairy-herd-improvement association has increased the cream checks about $250 a year on my 12 cows.
>
> It is the best-paying investment I ever made.
>
> By doing away with guesswork one can triple his profits and lessen his labor.
>
> The association culls the boarder cows and advertises the good ones.
>
> I found that my best cows were producing butterfat at a third the cost of the poorest one.

I offered to sell a cow for $75 before testing. She made 495 pounds of butterfat. I would not sell her now.

The dairy-herd-improvement association has added at least $25 a head to all the cattle I have sold.

The association has greatly improved the social life of the community.

What a change since the association was organized. Now we cooperate in buying feed, in hauling cream, and in holding public sales of tested cows. Every member grows alfalfa, keeps a purebred dairy sire, and raises the best of the heifer calves.

A VIRGINIA EXPERIENCE

A Virginia farmer, the owner of 91 cows, joined a dairy-herd-improvement association. During the first year he discovered that many of these cows were naturally very low producers. To make matters worse, careless feeders dished up the grain with a scoop shovel and fed all the cows alike regardless of production. As might be expected under those circumstances, production was low, feed cost was high, and income was low.

FIGURE 7.—She foraged on the very best of pastures

Seven years after this farmer joined the association the herd had been reduced from 91 cows to 54 high-producing cows. Milk production had advanced from 3,311 pounds per cow to 5,953 pounds. Butterfat production had advanced from 155 pounds per cow to 280 pounds. But, most marvelous of all, the income over cost of feed had jumped from 64 cents to $146.07 per cow per year—more than two hundred times as much. This increase in income over feed cost was due to better cows, better feeding, and to better marketing of the product.

At the end of the seventh year one average cow in the herd produced more income over cost of feed than was produced by the 91 cows. In fact it would require 228 cows like those in the original herd to produce as much income over cost of feed as was produced by one average cow in the later herd. Needless to say, the owner is a firm believer in the work of the well-managed dairy-herd-improvement association. (Fig. 6.)

HOW MOLLY'S LIFE WAS SAVED

A grade Guernsey cow named Molly lived on a beautiful dairy farm near the city of Baltimore. She drank pure fresh water from a sparkling upland stream, and all summer she foraged on the very best of pastures. (Fig. 7.) She did not know that her owner was ignorant of the quality of the milk she gave, nor that he thought the quantity rather small. She did not know that he had telephoned to a cattle dealer, telling him to come and get a certain cow named Molly. (Fig. 8.)

FIGURE 8.—Her owner telephoned to a cattle dealer

The dealer agreed but delayed his coming. About that time the county agent and the dairy extension field man induced Molly's owner to join a dairy-herd-improvement association (fig. 9), and one day the tester weighed and tested Molly's milk (fig. 10).

FIGURE 9.—Her owner joined a dairy-herd-improvement association

The test showed 5.5 per cent butterfat, and the tester advised that Molly be kept a little longer, because her milk more than made up in quality for what it lacked in quantity.

Before that testing year had run its course Molly had proved herself a high tester and persistent milker. Her daily yield was never large, but the total for the year was 5,967 pounds of milk, containing 330 pounds of butterfat. In production of butterfat Molly ranked among the highest in the herd. Her records saved her life.

WHAT DAIRY-HERD-IMPROVEMENT ASSOCIATION RECORDS REVEAL

BETTER COWS NEEDED

In many sections of this country we have enough cows but not good enough cows. Our slogan should not be "More cows" but "More good cows." Here is one place where there is an abundance of room at the top.

In the Newaygo County, Mich., association the herd that one year had the highest average production of butterfat per cow consisted of 10 cows and the herd that had the lowest average production consisted of 20 cows. The herd of 10 cows had a total income over cost of feed of $666, and the herd of 20 cows, $455. The owner of the larger herd needed 9 more cows of the kind he was keeping to get as much income over cost of feed as was produced by the smaller herd.

FIGURE 10.—Testing Molly's milk

It is better, however, to own 10 good cows than 29 poor ones. It demands less labor and other costs. To build up a herd of 10 good cows (fig. 11) requires much headwork. To take care of a herd of 29 poor cows requires much handwork. The dairyman who does not use his head must work that much harder with his hands.

FEEDING FOR PROFIT

A tabulation of more than 100,000 yearly records of association cows has shown that on an average the high producers of milk and butterfat consumed more dollars' worth of feed per cow than the low producers, but they also yielded a higher income over cost of feed. Evidently it pays to feed good cows well.

The dairy cow may be considered as a feed market. The low-producing cow pays a low price for feed and the high-producing cow pays a high price for feed. A tabulation of more than 100,000 yearly individual-cow records showed an average return of $2.36 for every dollar spent for feed. The returns varied from less than $1 to a little more than $3. The cow that returns a dollar for a dollar's worth of feed is a very poor feed market, but the cow that returns $3 for $1 worth of feed is a very good feed market. The dairy-herd-improvement association herd book, completely filled out and posted up to date, is one of the best feed-market reports the dairyman can have. It tells him how many dollars' worth of feed Spot, Daisy, and the rest of his cows are eating, also how much each cow is paying for her feed.

FIGURE 11.—To build up such a herd requires testing, not guesswork

GOING UP OR COMING DOWN

The dairy-herd-improvement association records show that some herds improve from year to year and that others decline. This was demonstrated in the case of two herds that were on test continuously during the first four years in one association. The results are shown in Table 2.

TABLE 2.—*Average butterfat production per cow per year in two herds of the same association*

	Herd A	Herd B
First year	377	234
Second year	350	244
Third year	321	302
Fourth year	313	315

When the work began herd A excelled herd B in butterfat production by a margin of 143 pounds per cow. In each successive year herd A went down and herd B went up in yield per cow until at the end of the fourth year herd B produced a trifle more butterfat per cow than herd A.

These figures show that membership in an association helps but little unless the lessons are put into practice. The owner of herd A should find out why the average butterfat production in his herd is gradually coming down, and he should find some means to face his herd the other way. The owner of herd B is doing very well. The average production of his herd is going up, because he is weeding out the poor cows and feeding the remaining ones better. He should do his best year by year to push the average still higher. No dairy herd has ever dropped so low that culling, feeding, and breeding could not build it up, and no herd is yet so high that these three factors can not lift it higher. The association records tell the true story and show whether production is going up or down.

A DAIRY DEAD LINE

The question is often asked: "When should a dairy cow be condemned because of low production?" That is an easy question to ask but not so easy to answer.

According to estimates of the United States Department of Agriculture, the average yearly production of our dairy cows in 1927 was 4,600 pounds of milk and 180 pounds of butterfat. Certainly no one will contend that a mature cow whose production is below that level should long be kept on a dairy farm. A tabulation of more than 140,000 yearly records of dairy-herd-improvement association cows has shown an average yearly production of 7,410 pounds of milk and 293 pounds of butterfat per cow. Many dairymen feel that a level of 6,000 pounds of milk and 240 pounds of butterfat per cow per year should be required of every mature cow in the herd. Some have fixed an even higher standard.

Many a good cow has lost her life because her owner did not know what she produced. Many a good cow's life is still in danger because her owner does not keep production and feed-cost records of his cows. It is easy to place the dead line at 6,000 pounds of milk and 240 pounds of butterfat a year, but it is not so easy to bring the record of every mature cow above that line. Culling alone will not do it without too much killing. Culling and feeding, together, will not do it without too much killing and too much cost. But culling, feeding, and breeding, all combined, will do it, and do it at a cost that ordinarily will leave a fair net profit.

DRY TOO MUCH OF THE TIME

In a Mississippi association, during the testing year 1921–22, one cow produced milk 7 months, made a butterfat production of 79 pounds, and an income of $7 over cost of feed. Another cow produced milk 11 months, made a butterfat record of 313 pounds, and an income over cost of feed of $64. In dollars' worth of feed the higher producer ate more than twice as much as the other cow, but she produced four times as much butterfat and nine times as much income over cost of feed. The good cow was a persistent high producer; the other was a very low producer. Even during the period when she was fresh she was a low producer, and she was dry too long.

A tabulation of more than 10,000 yearly individual-cow records from dairy-herd-improvement associations showed that on an average those cows remained in the herd 4.7 years from the time they reached production age. Similar studies of records by the Bureau of Agricultural Economics of the United States Department of Agriculture,[2] and by C. W. Larson[3] gave 4.43 years and 4.85 years, respectively. Figures from these and other sources indicate that on an average dairy cows remain in the herd less than 5 years from the time they reach production age. If that is true, the average dairy cow has already lived about one-third of her life before she directly pays a single dollar for her stable room and board. In other words, she lives 2½ years out of 7½ before she produces any milk. If during her 5 productive years she is dry 3 months in every 12, she is dry 1¼ years of the 5. Two and one-half years plus one and one-fourth years equal three and three-fourths years of nonproduction, exactly one-half of the entire lifetime of the cow.

FIGURE 12.—Her record is as persistent as the summer's sun

If our dairy cows freshened once a year on an average, which at present they do not, and if each were a persistent high producer, their productive lifetime in the herd might be 10 years instead of 5 and their income over cost of feed during all the years would be several times what it is now.

A low-producing dairy cow, if she yields a profit at all, may not yield one until she is 6 or 7 years old and she may cease to be profitable while still comparatively young.

A high-producing dairy cow begins to yield a profit at the age of 2 or 3 years. When she is 6 or 7 years of age her profits are very high, and she may continue to yield a profit until very late in life. (Fig. 12.)

The lifetime records of a low-producing cow may be likened to the daily course of the winter's sun, which rises late, remains low, lasts only a little while, then disappears. The lifetime record of a high-producing cow may be likened to the daily course of the summer's sun, which rises early, climbs to a great height, remains long, descends slowly, and seems reluctant to disappear.

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[2] SPILLMAN, W. J., DIXON, H. M., and BILLINGS, G. A. FARM MANAGEMENT PRACTICE OF CHESTER COUNTY, PA. U. S. Dept. Agr. Bul. 341, 99 p., illus. 1916.

[3] LARSON, C. W. MILK PRODUCTION COST ACCOUNTS, PRINCIPLES, AND METHODS. 60 p. New York. 1916.

WHEN COWS SHOULD FRESHEN

A tabulation of more than 10,000 yearly records of association cows showed that those cows which freshened in the fall and early winter did better in production of milk and butterfat and in income over cost of feed than those which freshened in the spring and summer. Those that freshened in the fall and winter produced 11 per cent more milk, 11 per cent more butterfat, and 11 per cent more income over cost of feed than those that freshened in the spring and summer.

While fall and winter freshening won on an average, they did not win on every farm nor in every association. The influence of date of freshening appears to be a local problem for which no general rule can be given.

FIGURE 13.—Following in the footsteps of her mother

VALUE OF THE HERD BULL

As a part of dairy-herd-improvement association work, more than 500 bulls have been proved by comparing the yearly production records of all the daughters (five or more) of each bull with the yearly production records of the dams of the daughters. Altogether the records of 3,257 daughters have been compared with those of their dams. On an average the dams produced 9,055 pounds of milk per year and the daughters 9,536 pounds. The dams averaged 346 pounds of butterfat a year and the daughters 387 pounds. The daughters, therefore, produced 5.3 per cent more milk and 11.8 per cent more butterfat than their dams. (Fig. 13.)

The figures showed that about one-third of the bulls lowered the production of the herds in which they were used, that about one-third brought small gains, and that one-third brought big gains. The dairy-herd-improvement association records, if studied carefully, will show which bulls are improving the herds in which they are being used. These records test the sires as thoroughly as they test the cows. The cow is tested through her own record; the bull is tested through the records of his daughters.

HOW TO START AND CONDUCT AN ASSOCIATION

STARTING THE ORGANIZATION

After a community has become convinced of the need of having a dairy-herd-improvement association, the next step is to organize. A meeting may be called and a temporary organization effected. The neighborhood is thoroughly canvassed until about 26 dairymen have agreed to become members. Another meeting is then called and a permanent organization formed. Officers are elected and a constitution and by-laws adopted.

The best experience shows that this work should be done under the direction of the dairy extension specialist and the county agent, and with the full cooperation of all local agencies.

In this bulletin is a draft of constitution and by-laws. These indicate a form of organization that will give satisfaction and meet the needs of most associations. Whatever adaptations are necessary to fit them to local needs and desires can readily be made.

The county agent, the State agricultural college, or the Bureau of Dairy Industry of the United States Department of Agriculture, will on application furnish copies of the constitution and by-laws, membership agreements, and also copies of the form to be used in making a contract between the association and the tester.

COST

Enough money must be raised each year to pay the tester's salary, which is usually somewhere between $75 and $100 per month, and to provide for the incidental expenses connected with the work. The testing outfit, costing about $50, must be purchased the first year. An additional $50 should pay for the sulphuric acid, breakage, record blanks, publicity, and all other incidental expenses necessary for the work for a year. The entire cost, including the board of the tester and his transportation from farm to farm, is not high for each member of the association. Generally the cost is distributed so that the owners of large herds pay more than the owners of small herds.

TESTING OUTFIT

The testing outfit consists of the following: Milk scales, Babcock tester and glassware, sample jars, sample dipper, test-bottle bath, drainage rack, supply of commercial sulphuric acid (specific gravity of 1.83), a set of computing tables, a suitable box with lock to hold the apparatus and to keep milk samples until they are tested.

SELECTING A TESTER

As a rule the members of the association must rely largely on the State agricultural college when it comes to the selection of a competent tester.

The tester should have some special training in testing in addition to farm experience. The more he actually knows about selection, feeding, and constructive breeding of dairy cattle, the greater will be the value of his services to the association. It is essential that he be a man of good habits, and neat and clean in every way. He must be the type of man that will be welcome in the homes of the community, because it is in these homes that he must live while working there.

The farmers, however, must not expect too much of the cow tester. He is there primarily to weigh and test the milk, to weigh the feed, and to keep complete and accurate records of the work. He may also advise the members of the association regarding the feed and care of each cow in the herd. He can not work miracles. He can not by any method of feeding get a yearly butterfat production of 300 pounds from the cow with ability to produce only 100 pounds.

WORKING WITH THE TESTER

The tester can be of great service if all the members of the association will work with him toward the building up of better herds of dairy cattle. The wide-awake tester is a willing worker. He begins his day in the early morning and continues until the milking is done at night and the samples are all put away under lock and key. He weighs the feed, weighs and tests the milk, and keeps the records constantly up to date. He is ready at all times to interpret the figures to the best of his ability and to work out with the farmers better methods of feeding, care, and management. To do all this and do it well, he must have the cooperation of the farmers in the association.

THE TESTER'S WORK

The tester visits each farm one day each month. Usually he arrives in the afternoon. That evening he weighs the feed, weighs the milk, and takes a sample of the milk for testing. He records all figures in the barn book, from which he transfers them to the herd book. The barn book is the tester's record of the work, and the herd book remains in the possession of the farmer as his record of the work. The next morning the tester again weighs the feed, weighs the milk, and takes a sample of the milk for testing. He thoroughly mixes the two samples of each cow's milk, and then tests the composite sample for percentage of butterfat.

From the herd book the farmer can at any time get the record of his herd and of each cow for every month from the beginning of the testing year. He can also get totals for each cow. The herd records include feed cost and production of milk and butterfat. The individual-cow records include all this and the number of pounds of each kind of feed consumed.

At the end of the testing year the farmer can get from the herd book the yearly summary of his herd and of each cow. As the years pass he can compare the yearly records and determine what progress his herd is making and what progress each cow is making. If the herd books are carefully and completely filled out, the farmer can get all this information very quickly and from this knowledge of the records of his cows he can go forward, without guesswork, in the improvement of his herd. With a well-kept herd book the farmer is able to build up his herd quickly through intelligent selection, breeding, and feeding.

HOW TO OBTAIN COMPLETE RECORDS

The question is sometimes asked: How can testers be induced to fill out the records accurately and completely at the end of the testing year? It has been found in practice that it is not advisable to hold back part of the tester's salary until he turns in his records properly filled out, as that is a penalty which antagonizes the tester and results in hard feelings to no purpose. A better way is to offer the tester a bonus to be paid when he does fill out the records in proper form. He will work harder to obtain a bonus than to avoid a penalty. With the offer of a substantial bonus for the satisfactory completion of the year's work by the tester, it is believed that every tester will be induced to turn over to the State records of the highest value, and that by so doing each tester will better serve the interests of the farmers who belong to the local association.

MILKING AT REGULAR TIMES

Many farmers weigh the milk of each cow at every milking. This enables them to detect any gain or falling off in milk flow and to feed according to milk production. By the use of the milk scales, if the milking is done at the same time every day, the dairyman can readily determine which of his cows are responding to better feed and care. It is especially important that the milking should be at regular times on the day the tester is there and the day before he comes, because the total production for the monthly testing period is usually calculated entirely from the records made the day the tester is on the ground. There should be no temptation on the part of the farmer to inflate the records through irregular milking periods, because the primary purpose of dairy-herd-improvement association work is to let the farmer himself know the true production and feed-cost records of his cows. Knowing these records he can select, breed, and feed intelligently.

COMMUNITY DEVELOPMENT

One of the most valuable advantages of organized cow testing is the development of the community. The farmers of some associations get together once a month to discuss the business of the association and to exchange ideas regarding better methods of dairying. Sometimes these meetings take the form of an automobile tour, a summer picnic, or a field day, and a definite program is carried out.

Make the program entertaining and inspirational as well as educational. It should be made so interesting and valuable that all who come this year will want to come next year. In discussing association records, herds should be referred to by number rather than by name.

Placing some of the best cows on exhibition will add interest to the meeting. A judging demonstration or judging contest will generally appeal to most of the people present. An automobile trip to some of the best dairy farms of the community has been tried out and has proved to be valuable and profitable. This trip enables the farmers to see the best cows belonging to members of the association and to observe the methods of the best farmers in the community.

PRODUCTION AND INCOME

HOW THE INCOME CLIMBS

High-producing dairy cows are profitable cows. In a tabulation of more than 100,000 yearly records of cows in dairy-herd-improvement associations, where the income was from the sale of butterfat, the group of cows having an average yearly butterfat production of 100 pounds made an average income of $14 over cost of feed. At 200 pounds of butterfat a year the income over cost of feed was $54; at 300 pounds it was $96; and at 400 pounds it was $138. This does not mean that every cow that produces 400 pounds of butterfat a year will bring in an income over cost of feed of $138, but it does mean that this is the relative advantage and that under normal conditions such a cow is many times more profitable than the one that produces only 100 pounds of butterfat.

This study covers the period 1925 and 1926, and includes records from various parts of the United States. The feed cost and income figures vary for different years and for different geographical districts. For example, in most of the leading dairy districts, a cow that produces 100 pounds of butterfat a year does not ordinarily yield an income over cost of feed; yet in some of the less-developed districts where feeds are cheaper such cows may return a small income above feed cost.

On an average, 1 cow in the 400-pound group produced approximately the same income over cost of feed as 11 cows in the 100-pound group. Most dairymen would rather take care of 1 good cow than 11 poor ones, yet in many of our dairy herds the 100-pound cows are much more numerous than the 400-pound cows. It is almost incomprehensible that any dairyman will continue to care for low-producing, unprofitable cows in his herd year after year when there are so many other and more worthy objects of charity.

As average butterfat production per cow increased from group to group, the gain in income over cost of feed was very regular. As a rule, a gain of 50 pounds in production of butterfat per cow was accompanied by an increase of $20 in income over cost of feed. The figures also showed that very few association cows are fed beyond the point of economical production. The figures invariably showed that the highest-producing group was the most profitable group of dairy cows.

THE COST OF KEEPING SCRUBS

The average yearly butterfat production of all the dairy cows in this country has been estimated at about 180 pounds. Assuming that this is the average production and that half the dairy cows are below average, we bump up against the astounding fact that we are feeding good hay and grain and pasture to about 10,000,000 low-producing dairy cows. It costs about $500,000,000 to feed these cows and about $500,000,000 more for labor and for overhead expenses. If the dairy-herd-improvement association eliminates the scrubs and establishes well-fed, well-bred, high-producing cows on every dairy farm it will have accomplished its chief purpose. Even then, however, its work will not all be done, because these higher standards must be maintained.

POWER IN ACTION

To get anything out of dairy-herd-improvement association work the dairyman must make use of the information obtained from a careful study of the records. If he does this, the records will be a gold mine of useful information to him. From his knowledge of the records of dams and daughters the dairyman can determine definitely what progress his herd is making due to breeding. From his knowledge of production and feed-cost records he can, without guess work, eliminate all cows that do not yield a profit, and he can feed the remainder according to their known production. As the years pass he can eliminate all cows except those that yield large returns; and gradually, but certainly, he can build up a herd of high-producing, profitable dairy cows.

CONSTITUTION AND BY-LAWS FOR THE COOPERATIVE DAIRY-HERD-IMPROVEMENT ASSOCIATION

(*As adopted by the dairy-herd-improvement association committee of the American Dairy Science Association*)

CONSTITUTION

ARTICLE I.—NAME

The name of this association shall be the ——— Dairy-Herd-Improvement Association.

ARTICLE II.—OBJECT

The object of this association shall be to provide means and methods for improving the dairy herds of members. This will be accomplished through the keeping of production, feed, and income records of each cow, on the basis of which unprofitable cows may be eliminated and feeding done more economically.

ARTICLE III.—PLACE OF BUSINESS

Its principal office and place of business shall be at ———.

ARTICLE IV. MEMBERSHIP

This association shall be composed of dairymen or owners of dairy herds who agree to comply with the members' agreement, and who are acceptable to the board of directors.

ARTICLE V. MEETINGS

This association shall meet annually for the election of a board of directors and for the transaction of other necessary business at such time and place as may be determined upon by the board of directors. All members shall be notified at least one week in advance of such meetings. Special meetings of the association may be called by the president or the board of directors, notices thereof at least two days in advance to be given to all the members of the association. Meetings of the board of directors shall be called by the secretary on the order of the president or three members of the board.

ARTICLE VI. ORGANIZATION

The governing body of this association shall consist of a board of directors composed of five active members, who shall elect from their own number a president, vice president, secretary, and treasurer, whose duties shall be those usually devolving upon such officers. The first election of officers shall be held immediately after the election of the board of directors. All officers and directors shall hold office until their successors are elected. Vacancies occurring in the board of directors shall be filled by a majority vote of the remaining members of the board.

ARTICLE VII. BUSINESS

Authority to conduct the business of the association shall be vested in the board of directors.

ARTICLE VIII. ELECTION

Election of all officers and directors shall be by majority vote.

ARTICLE IX. AMENDMENTS

This constitution may be amended by a two-thirds vote of the active members of the association present at any annual meeting.

BY-LAWS

ARTICLE I. ORDER OF BUSINESS

1. Reading of minutes of previous meetings.
2. Reports of secretary and treasurer.
3. Reports of committees.
4. Unfinished business.
5. New business.
6. Election of officers.

ARTICLE II. QUORUM

Three members of the board of directors shall constitute a quorum.

ARTICLE III. AMENDMENTS

The by-laws may be amended by a two-thirds vote of the active members of the association present at any annual meeting.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

October 3, 1929

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This bulletin is a contribution from

Bureau of Dairy Industry	O. E. REED, *Chief.*
Division of Dairy-Herd-Improvement Investigations.	J. C. MCDOWELL, *Chief.*

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SOYBEAN HAY AND SEED PRODUCTION

By W. J. Morse, *Senior Agronomist, Office of Forage Crops and Diseases, Bureau of Plant Industry*

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INTRODUCTION

THE SOYBEAN has gained rapidly in importance as a hay and seed crop during the last decade and seems to have found a permanent place in many farming systems of the eastern half of the United States. The development of more economical methods and suitable machinery in harvesting and handling the crop has been one of the most serious problems of successful production. The methods employed in the production of soybean hay and seed vary with the types of farming practices in those States growing large acreages of the crop, and increased acreage and greater utilization of the soybean have brought about more efficient methods and new or improved machinery. Many types of machines, ranging from the single-row harvesters to the combine used in the harvesting of small grains, are now available for the more economical production of seed. Perhaps no greater advance has been made in any farm practice than in the harvesting of the soybean crop.

SOYBEAN HAY PRODUCTION

The soybean is not a difficult crop to grow for hay, and when cut at the proper stage of growth and properly cured it makes excellent hay of high feeding value. An annual legume widely adapted to various soils, the soybean can be used in any rotation and is grown successfully on soils too acid to grow red clover, sweet clover, or alfalfa. It is not to be considered as a competitor of clover or alfalfa in regions suitable to these crops, but rather as a supplement and addition to them. In case of the failure of an old or new clover or alfalfa seeding, winter grain, or a spring crop, there is ample time to grow a crop of soybeans for hay. Soybeans are also excellent as a summer catch crop following early crops or in fields not in the regular rotation.

TIME OF CUTTING

The soybean may be cut for hay at any time from the forming of the pods until the seeds are three-fourths grown. The crop is best fitted for hay, however, when the seeds are about half developed, and it is at this stage that the best quality of hay may be obtained. If the crop is cut earlier, the percentage of protein will be higher, but the total yield will not be so large, and the difficulty of curing will be much greater. If the cutting is delayed, however, the stems rapidly become hard and woody, and if left too long much loss in leaves will occur, thus decreasing the palatability and the feeding value. Table 1 shows the variations in the composition of hay of the Peking variety harvested at different stages of development.

TABLE 1.—*Composition of soybean hay of the Peking variety at different stages of development*

Stage of growth	Constituents (per cent)					
	Moisture	Protein	Fat	Nitrogen-free extract	Fiber	Ash
Full bloom	5.33	17.09	1.45	34.60	23.31	18.22
Pods forming	5.28	19.31	1.87	35.66	26.49	11.39
Beans half developed	5.04	16.59	3.02	36.28	26.30	12.77
Beans fully developed	5.29	16.84	8.79	34.93	25.13	9.06

METHOD OF CUTTING

Various methods of cutting the soybean crop for hay have been practiced, but the mowing machine is the implement most generally used. The self-rake reaper is used successfully in many sections in cutting the crop for hay, for soilage, and for silage; the binder is also used in some sections in cutting for hay and silage. Soybean plants contain a rather high percentage of moisture, and when cut for hay with the binder, unless the bundles are loosely bound, there is danger in damp weather of some loss from molding in the center of the bundles.

CURING SOYBEANS FOR HAY

Some experience is necessary in curing soybean hay, as it is more difficult to cure than alfalfa or clover, but it may be handled by about the same methods. Greater difficulty will be experienced in curing the hay of late varieties than that of varieties reaching full maturity in the given locality. The stems of soybeans cure slowly; consequently, special attention is required to save the leaves, which, as with all legume hays, are the most valuable part.

The methods to be used will vary in different sections, but hay of good appearance and quality can generally be made if the producer is careful. Soybean hay is not injured by wet weather to as great an extent as are other legume hays. Weathered soybean hay, although probably not as nutritious as well-cured hay, is of good feeding value and is readily eaten by livestock.

The most common method employed is to cut the crop as soon as the dew is off the plants and leave it in the swath until thoroughly wilted. After wilting and before the leaves become dry and brittle the hay is raked into windrows and left a day or two, depending on the weather, and then placed in tall narrow cocks or bunches to complete the curing. After four or five days of fair weather, soybean hay is ready to be stacked or housed. The bunches or cocks should be opened a few hours before hauling to dry out thoroughly.

The curing of soybean hay entirely in the swath is practiced in many sections. The crop is cut with the mower and left to lie until entirely cured. The hay is then raked either on a cloudy day, in the evening, or in the morning when the dew is on. Although the crop is cured more rapidly by this method, the hay is more subject to bleaching in case of prolonged wet weather and to greater loss of beans and leaves. When cured in the swath the hay may be raked with a side-delivery rake and taken up with the hay loader. (Fig. 1.)

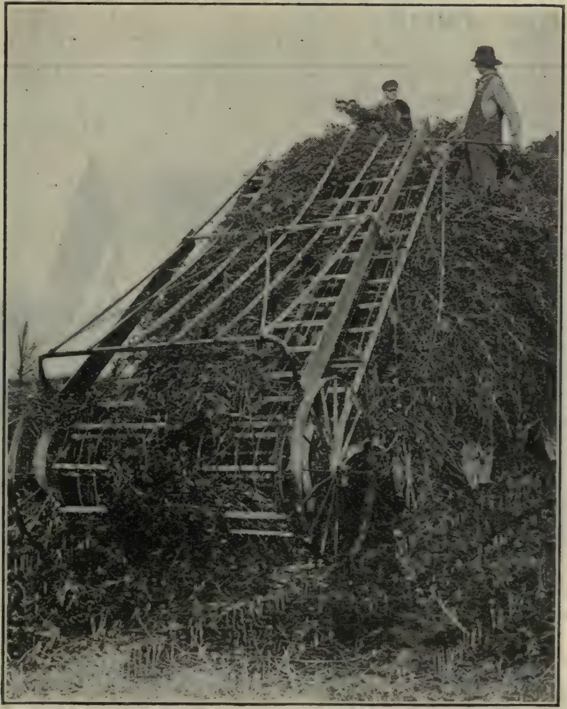

FIGURE 1.—Soybean hay after curing in the swath or windrow may be taken up with the drum hay loader

Another method successfully used is to allow the crop to lie in the swath for a day or two and then rake into windrows to complete curing. Usually it will be found necessary to turn the windrows. Hay of a better color than that cured by the swath method is thus obtained, but in rainy weather the windrows are hard to dry out, more handling is required, and the result is a greater loss of leaves and beans.

The use of curing frames or poles (fig. 2) is very generally practiced in the Southern States and to some extent in other sections under unfavorable weather conditions. Although the hay, as a rule, should be well wilted when placed on a frame or pole, well-cured hay may be obtained by placing the crop on the frames or poles as soon as cut.

Soybean hay should be thoroughly cured before it is stacked, housed, or baled. There is danger of molding when the hay is stored or baled too green or too soon after a rain. When left in the open, the hay should be placed in good-sized stacks and grass or some other material that sheds rain placed over each stack. Placing poles or logs in the center of the stack so as to provide air passages will greatly lessen the danger of spoiling. Molding also may be avoided by alternating a layer of soybean hay in the stack or mow with a layer of straw.

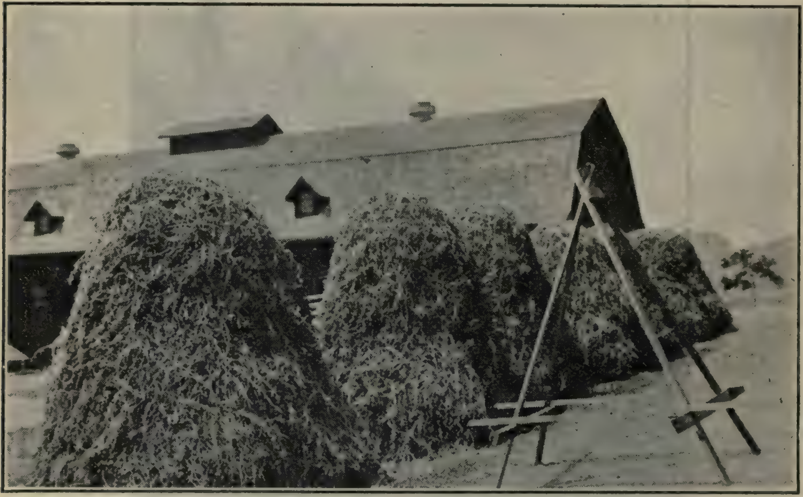

FIGURE 2.—The use of curing frames is very generally practiced in the Southern States

BALING THE HAY

The baling of soybean hay has increased to a very considerable extent in many sections of the Southern and Corn Belt States. Although the hay is often baled directly from the windrow or from the cocks, the practice is not a desirable one in humid regions. The most serious difficulty is that hay from the field is often baled too soon. It may appear to be sufficiently cured, but upon examination it will be found that only the leaves are dry enough, while the stems and pods are still sappy. If such hay is baled, it will go through the process of sweating, and a damaged hay of poor quality will result. In baling soybean hay from the field the hay should be thoroughly cured. A test that will indicate to a certain extent the fitness of the hay for baling is to try a handful of hay by twisting it in the hands. If it breaks easily when twisted once or twice, it is well cured; but if it is hard to break and sap is squeezed out of the stems or pods, it is not in condition to be baled. After soybean hay has been stacked or housed, a process of sweating takes place, requiring four to eight weeks, after which there is practically no danger of heating in the bale.

YIELDS OF HAY

Soybeans will yield from 1 to 3 tons of hay to the acre, and occasionally 4 to 5, depending upon the fertility of the soil and the season. Good forage varieties under favorable conditions should average at least 2 tons to the acre. In the Southern States the late-forage varieties of the Otootan, Barchet, and Laredo types under favorable soil and seasonal conditions average 4 or more tons to the acre.

SOYBEAN HAY GRADES

Tentative United States standards[1] have been prepared by the Bureau of Agricultural Economics, United States Department of Agriculture, to provide a definite basis of quality for use in the marketing of soybean and soybean mixed hay. Although the present production of soybean hay for marketing is not large, uniform standards undoubtedly will aid materially in stabilizing the industry, in promoting better production and curing methods, and in developing more extensive marketing of soybean hay in regions of surplus production.

SOYBEAN SEED PRODUCTION

The more extensive use of the soybean for pasturage, forage, and in the manufacture of oil and soybean meal and food products has resulted in an enormous increase in acreage and production of seed. The soybean is a profitable crop when grown for seed purposes, and the seed-growing industry has developed extensively in many sections of the Corn Belt and Cotton Belt States.

The character of growth, uniform maturing habit, and heavy seed yields contribute to the ease of harvesting and recommend the plant for seed production. When soybeans are grown for beans alone, shattering is a serious fault, and inexperienced growers are likely to sustain heavy loss through lack of knowledge and improper handling of the crop.

All soybeans are strictly determinate as to growth; that is, the plants reach a definite size, according to variety and environment, and then mature and die. If not harvested at the proper stage of maturity, nearly all varieties shatter their seed somewhat, especially during changeable weather. Special attention, therefore, is required when the plants approach maturity to prevent serious losses from shattering. Some varieties shatter very badly and others, such as the Biloxi, Manchu, and Mansoy, scarcely at all.

The harvesting of seed has been one of the most difficult problems in the development of the industry. Until the advent of the combine and special harvesters and threshers, growers of soybeans had to use the machinery at hand, with more or less unsatisfactory results. Improved methods and machinery for handling the seed crop tend to assure greater agricultural development of the soybean in America.

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[1] UNITED STATES DEPARTMENT OF AGRICULTURE. BUREAU OF AGRICULTURAL ECONOMICS. TENTATIVE UNITED STATES STANDARDS FOR SOY-BEAN AND SOY-BEAN MIXED HAY. 2 p. [1928.] [Mimeographed.]

TIME OF HARVESTING

When the soybean plant approaches maturity, the leaves begin to turn yellow and drop; and before all of the pods are fully mature the leaves, except in a few varieties, have fallen. In general, the best time to harvest, except when a special bean harvester or combine is used, is when the pods are fully mature and the seed is in the hard-dough stage. If cut at an earlier stage, the plants cure more slowly, the yield of seed is lessened materially, and an inferior quality of seed results. On the other hand, if the seed is allowed to become fully mature, there is unnecessary loss from shattering. If, however, the crop has been allowed to reach full maturity, this loss from shattering can be prevented by cutting the plants in the morning, when they are damp. Varieties that do not shatter easily may be allowed to stand until fully mature.

When special bean harvesters and the combine harvester and thresher are used it is necessary for the seed to reach full maturity to obtain the best results. The time of harvesting will vary somewhat with weather conditions. In a hot, dry fall greater care should be taken in the harvesting of varieties tending to shatter. A few varieties of the nonshattering type can be left until fully mature in almost any kind of season with little or no loss of seed.

Growers with little experience often attempt to obtain hay as well as seed from the same crop, but there is no stage at which the soybean can be cut for hay and seed at the same time if quality and yield are to be considered. For the best quality of hay the crop should be cut three to four weeks before it would be harvested for a high quality of seed.

METHODS OF HARVESTING

In the different sections where the soybean is grown largely for seed production, various methods of harvesting are used. The most successful of these methods include the grain binder, the mower, with and without a side-delivery attachment, the self-rake reaper, special row and broadcast bean harvesters, and the combine.

When the cutting is done with a mowing machine, it is well to have a side-delivery attachment, as with this attachment the horses and mower wheels will not travel on the swath of cut beans and cause unnecessary shattering and loss of seed. If cut with a mower without such an attachment, however, the plants should be moved out of the way of the team at every round, or the crop should be cut while damp or at a little earlier stage of maturity.

With the taller growing varieties, if the plants are not too coarse and too mature, the grain binder is rather widely used to good advantage. For the best results the crop should be cut before all of the leaves have fallen or when damp, as the plants will cut more easily and less loss will result from shattering. The bundles should be comparatively small, loosely bound, set up in small shocks, and allowed to cure in the field. This method is especially valuable when winter wheat follows soybeans in the rotation. The wheat drill may follow immediately behind the binder, and with the bundles of beans falling on the drilled land there is no interference in the sowing of the wheat.

The self-rake reaper (fig. 3) has given very satisfactory results, as the plants are placed in bunches out of the way of the machine and the horses, and may be left to cure as they are, or they may be placed in small loose cocks.

Varieties of the Wilson, Virginia, Laredo, and Otootan types frequently tend to lodge badly in very fertile soils. If the crop has lodged to any considerable extent, harvesting becomes a rather difficult task. Extension guards bolted to the sickle bar will aid in picking up the lodged plants and will make the harvesting much more efficient.

METHODS OF CURING AND HANDLING

When cut with a mowing machine with an attachment or with a self-rake reaper, the plants may be placed in small cocks. These piles or cocks should be left for four or five days in good drying weather or until the beans are found to be fairly dry in the pods. Wet weather does not seriously injure the crop, provided the plants are not allowed to rest on the ground for any length of time. If rain occurs, the piles should be watched carefully and turned frequently. In the handling of the crop, during or after curing, the plants must be tough from dew or rain to prevent loss from shattering.

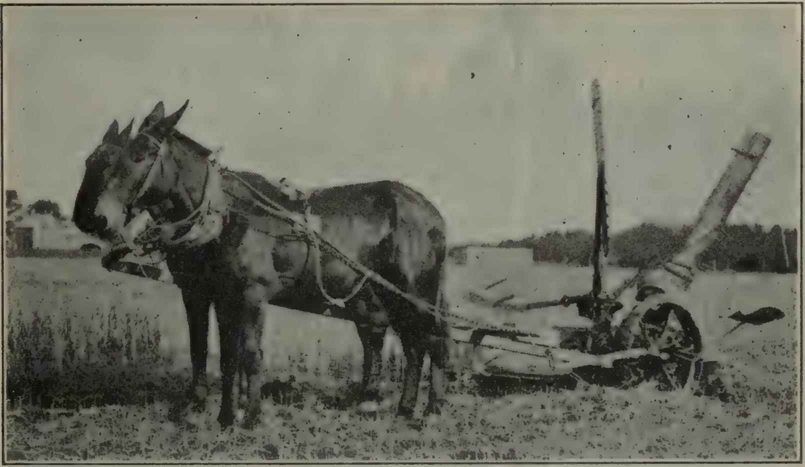

FIGURE 3.—The self-rake reaper which has given very satisfactory results in cutting soybeans for seed

Where a binder is used, the bound bundles should be shocked 8 or 10 to a shock (fig. 4) and allowed to remain until thoroughly dry.

Hay caps are not necessary when the piles or bundles are properly shocked, and the shocks may be left in the field until threshing time, or, if then thoroughly dry, they may be housed or stacked and threshed later. If the time of threshing is indefinite and if it is necessary to remove the crop from the field after curing and if housing space is not available, the crop can be stacked with excellent success. Soybeans are stacked in much the same way as small grains.

METHODS OF THRESHING

The ordinary grain separator (fig. 5) can be adjusted to thresh soybeans successfully, but if used as equipped for small grains it will crack a large percentage of the beans. The chief cause of split beans is the high speed of the cylinder, which should be reduced to approximately one-half to one-third of the normal threshing rate. The other parts of the separator should be maintained, however, at normal speed, and this may be accomplished by doubling the size of both cylinder pulleys. If the beans are dry, no concave teeth are necessary; a board may replace the blank concave. If the pods are tough, a special set of thin concaves may be used, or most of the concave teeth may be removed. Good judgment on the part of the operator will enable him to adjust the ordinary separator so that the beans may be threshed with little splitting. Some manufacturers have special pea and bean hulling attachments for grain separators, and these do very satisfactory work. These attachments may be added to the ordinary separator at small cost.

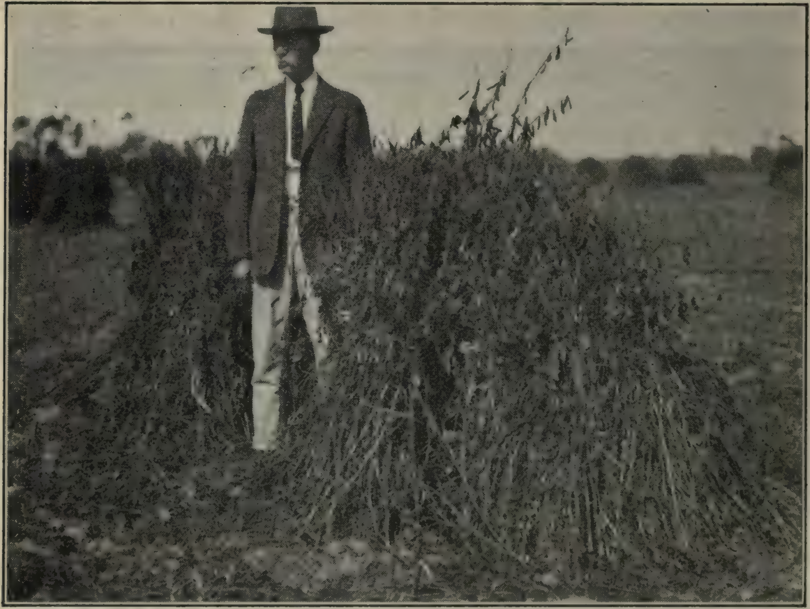

FIGURE 4.—When cut with a binder, the bundles of soybeans should be shocked and allowed to remain in the field until thoroughly cured

Pea and bean separators of different sizes are used in many of the soybean-producing sections. These machines do clean hulling and split practically none of the beans. They are more satisfactory and economical where a considerable acreage of soybeans is grown.

In some sections the corn shredder has been used to advantage, and if the beans have been properly cured and dried they shell out very readily with this machine.

Soybeans if thoroughly dry can easily be threshed with a flail. If only a small acreage is involved, this method is practicable and economical.

SPECIAL HARVESTING AND THRESHING MACHINES

In the Southern States, where the soybean is grown extensively, the harvesting from mature standing vines by special harvesters, of which there are several types, has become quite common. The commonest type is a 2-wheeled boxlike machine (in some instances improved by a cleaning attachment), drawn by two horses. (Fig. 6.) As the machine passes over the row, four sets of rapidly revolving rods or long teeth on a large cylinder shatter or beat the beans from the pods into the body of the harvester. As the machine moves up the row, the harvested seed is raked by hand to the rear of the box. When the box is filled, the seed is removed and the pods and trash screened out. Under favorable conditions, two men with a team can harvest 5 or 6 acres a day, and although there is some loss of beans, this loss is compensated for in most cases by the saving of time and labor. These machines are best adapted to harvesting varieties of the bush type grown in rows 32 to 42 inches apart, although one type of harvester is suitable for harvesting beans drilled in close rows. With vining varieties only fair work can be expected, and that only where the plants are not lodged too badly. If the growth is rank and lodged to any extent, the best results will be obtained by making two trips in opposite directions over the row.

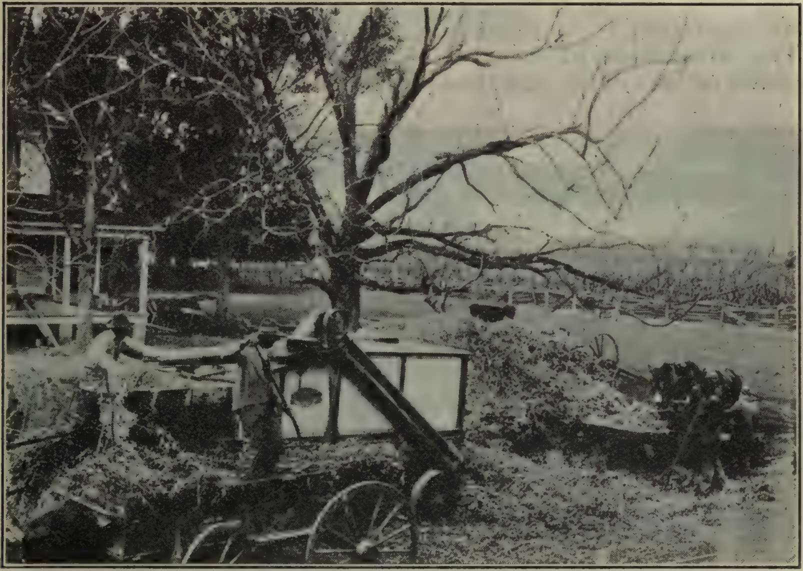

FIGURE 5.—The ordinary grain separator can be adjusted to thresh soybeans successfully

Soybeans have been harvested and threshed successfully with combines.[2] (Fig. 7.) Several types of combines are now used extensively in the large soybean-producing sections of the Corn Belt States. All of these machines work on the same general principle; that is, they cut the mature plants and elevate them to the cylinder, where the beans are threshed out. After passing over the screens and through the air blast as in an ordinary thresher, the beans are carried to a bin on the machine and then run directly into a wagon at the side of the combine or run into sacks which are tied and dropped from the machine. The straw is carried to the rear of the machine, where it may be distributed over the field by a straw spreader, or if desired for feeding or bedding, it may be placed in windrows for later gathering.

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[2] REYNOLDSON, L. A., MARTIN, J. H., and HUMPHRIES, W. R. SHALL I BUY A COMBINE? U. S. Dept. Agr. Farmers' Bul. 1565, 18 p., illus. 1928.

To prevent the beans from splitting when harvested with the combine, the speed of the cylinder, as with the ordinary separator, should be about half the speed used for harvesting wheat. The separating unit of the machine should be kept at the same speed as with wheat to insure proper cleaning and quick disposal of the threshed material. No concave teeth are necessary if the crop is uniformly mature, but if the beans are not thoroughly ripe, concaves are needed to insure clean separation.

The advantages of using the combine as compared with other methods of harvesting and threshing soybeans are the saving of labor and the reduction of harvesting costs, reduction in loss of beans, early clearing of fields for tillage operations, distribution of the straw on the land, and earlier marketing of the beans. Moreover, beans on standing plants are not so likely to be injured by bad weather as those harvested by ordinary methods and left in the field to be threshed later. The principal objections to using the combine are the large investment required and the difficulty of saving the straw, which might be used for feeding.

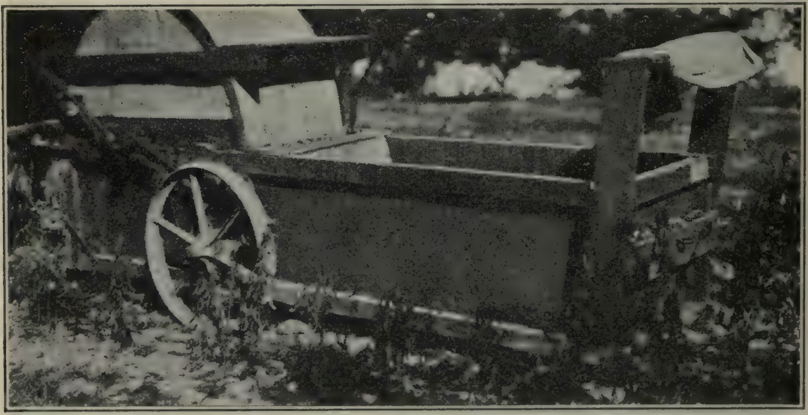

FIGURE 6.—A special soybean harvester used to gather soybean seed from the standing mature plants

PROPORTION OF STRAW TO SEED

The proportion of soybean straw to a bushel of seed varies widely according to variety. In general, the varieties giving the highest seed yields have a comparatively low proportion of straw to seed. Data obtained from 5-year average yields of seed and straw by the Ohio Agricultural Experiment Station[3] are shown in Table 2.

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[3] WILLIAMS, C. G., and PARK, J. B. SOYBEANS: THEIR CULTURE AND USE. Ohio Agr. Expt. Sta. Bul. 312, p. 581–600, illus. 1917.

TABLE 2.—*Relative yields of straw to seed in different varieties of soybeans*

Variety	Yield per acre, 5-year average		Weight of straw per bushel of seed	Ratio of straw to seed
	Seed	Straw		
	Bushels	*Pounds*	*Pounds*	
Cloud	18.34	2,510	137	1 : 2.3
Ebony	23.78	2,166	91	1 : 1.5
Elton	26.51	1,906	72	1 : 1.3
Habaro	23.70	2,134	90	1 : 1.5
Hamilton	23.49	2,636	112	1 : 1.8
Ito San	21.17	1,956	92	1 : 1.5
Medium Green	23.87	2,185	91	1 : 1.5
Midwest	24.06	2,278	95	1 : 1.6
Mikado	19.85	2,114	106	1 : 1.7
Peking	14.01	2,292	164	1 : 2.7

YIELDS OF SOYBEANS

The best producing varieties of soybeans, when grown alone for beans under proper culture and favorable conditions, yield from 25 to 40 bushels (60 pounds per bushel) to the acre. Yields, however, in different sections range from 15 to 25 bushels in the Northern and Central States and from 15 to 35 or more bushels in the Southern States. Maximum yields of 50 or more bushels to the acre have been reported from North Carolina and Tennessee. Yields of the same variety vary greatly in different sections, which may be attributed in many cases to the adaptability of the variety to certain localities. In addition to varietal adaptability, yields also vary with methods of culture, seasonal conditions, soil, and climatic adaptations.

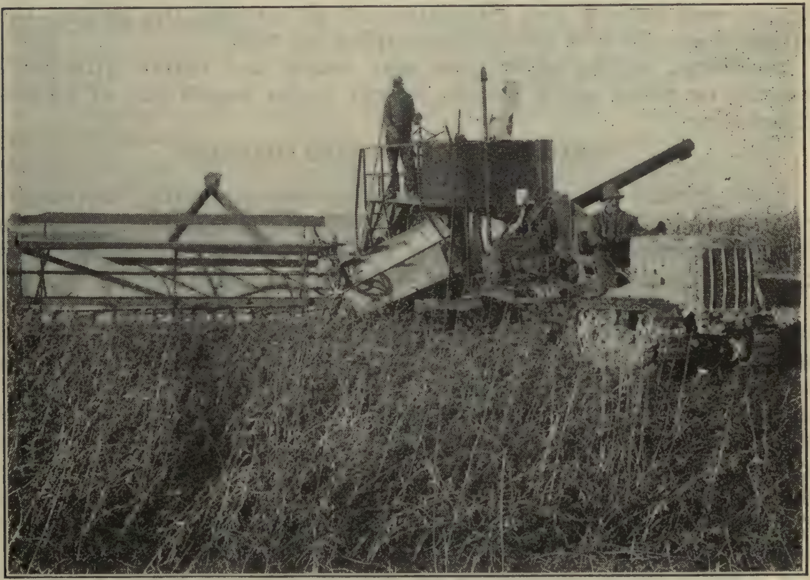

FIGURE 7.—Soybeans are harvested and threshed successfully with combines

STORAGE OF SOYBEANS

As soybeans spoil rather easily if not properly handled, care should be exercised in curing and storing. After threshing, the beans should be watched carefully to avoid heating and molding. Heating is especially liable to occur if the seed is bulked in large quantities in a bin or a poorly ventilated room, and this is almost certain to result if the beans are not fully dry when threshed. When the beans are thoroughly dry there is little danger of heating. In Manchuria soybeans are thoroughly dried and then placed in sacks, which are built up in large ricks and covered with matting. The maximum percentage of moisture with which soybeans may be stored safely has not been definitely determined. However, when the beans are sound, well matured, and practically free from foreign material they have not been found to go out of condition when stored, either in sacks or in bins, with 16 per cent moisture. If the beans are to be used for seeding purposes or if they are immature or contain a high percentage of damaged beans and foreign material, they should be permitted to dry out more thoroughly by spreading them on a floor immediately after threshing and turning them over from time to time before putting them in sacks or bins. The storeroom should be dry and have a free circulation of air around the sacks. Cross piling is an effective way of accomplishing this.

Soybeans, unlike most peas and beans, are rarely attacked by weevils or other grain insects, except under conditions of excessive infestation.

GRADING AND MARKETING SOYBEANS

United States standards[4] for grading and marketing soybeans are now used extensively in the large producing sections. Federal soybean inspection is authorized by a clause in the annual appropriation act for the Department of Agriculture. The general plan for conducting this service provides for the employment of soybean inspectors at shipping points and at important terminal markets under cooperative agreements between the Bureau of Agricultural Economics and organizations such as State departments of agriculture, commercial exchanges, and dealers' or growers' associations. Any person who has a financial interest in a lot of soybeans and who desires to obtain inspection of the lot should make application for inspection to any Federal soybean inspector. The application for this service may be made also direct to the Bureau of Agricultural Economics, Washington, D. C. The adoption and use of the United States standards by all agencies engaged in handling soybeans should promote uniform grading and facilitate the marketing of the commodity.

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[4] UNITED STATES DEPARTMENT OF AGRICULTURE. BUREAU OF AGRICULTURAL ECONOMICS. HANDBOOK OF UNITED STATES STANDARDS FOR SOYBEANS. U. S. Dept. Agr., Bur. Econ. Form HSF-899, 20 p., illus. 1928.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

October 5, 1929

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FARM DRAINAGE

By LEWIS A. JONES, *Senior Drainage Engineer, Division of Agricultural Engineering, Bureau of Public Roads*

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INTRODUCTION

IN A LARGE PART of the United States, profitable farming is dependent upon artificial drainage of the land. More than 10 per cent of the improved acreage in farms has been provided with ditches or tile drains,[1] but undoubtedly a much greater area is not yielding full return upon the money and labor spent because of inadequate drainage. Great damage to a crop because of inadequate drainage is usually recognized, but too often the loss is considered unavoidable, and it is hoped that the following season will be more favorable. That hope frequently is realized, and a fair crop makes many forget that future seasons will often be unfavorable and that other losses are certain to occur. A poorly drained field, which in some seasons is productive and in others is not, may be more detrimental to a farmer's success than swamp land. When a field is plowed, planted, and cultivated, and then no crop is harvested, not only is the land unproductive, but the labor, fertilizer, and seed likewise are lost.

BENEFITS FROM DRAINAGE

A wet soil is cold, because it takes many times as much heat to warm water as to warm a like quantity of the earthy particles, and relatively almost none to warm the air that replaces the moisture drained from a soil. The bacteria that are necessary in preparing the soil elements for plant food are lacking in a wet soil or are deficient in numbers, because they require air and warmth. A soil that is wet for long periods is apt to be compact (tight); and when plowed it does not have a good tilth, but is so hard that plant rootlets spread through it slowly and with difficulty, whereas they spread readily through a well-drained soil with good tilth.

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[1] UNITED STATES DEPARTMENT OF COMMERCE. BUREAU OF THE CENSUS. FOURTEENTH CENSUS OF THE UNITED STATES TAKEN IN THE YEAR 1920. v. 7, p. 372. Washington, [D. C.] 1922.

Drainage of the soil firms it and fits it for plowing and planting earlier in the spring and permits cultivation sooner after rains than is possible in undrained soil. In a well-drained soil beneficial bacteria can work effectively, plant-food elements are made more rapidly available, and the plants grow faster and stronger.

Drainage of the wet spots makes it possible to plow, plant, or cultivate the entire field at the same time, when the soil is in good condition. A uniform and increased yield usually is obtained over the entire field with the expenditure of less time and labor than was required before the wet spots were drained. In a soil that is saturated nearly to the surface during the spring and early summer, the roots of the crop spread out near the surface. Later, when summer droughts occur, the water table falls below this root zone, and the crop "burns out." In well-drained land the roots extend downward in the deeper root zone and the plants are better able to withstand the drought. Figure 1 illustrates the difference in root systems in drained and undrained soil. These benefits, which may often be obtained in fields that seem to need little if any drainage, are not sufficiently appreciated.

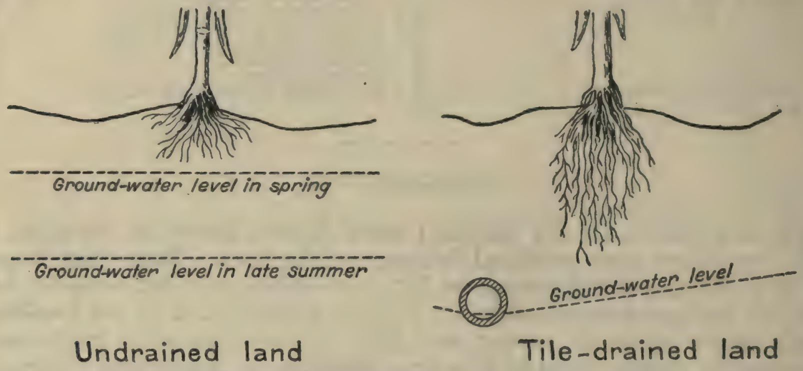
Ground-water level in spring
Ground-water level in late summer
Undrained land
Ground-water level
Tile-drained land

FIGURE 1.—Difference in root systems in drained and undrained soil

SURFACE DRAINAGE

Surface drainage is the removal of water from the ground surface, in order that the excess moisture in the soil may be removed as promptly as possible by evaporation from the ground surface and by percolation through the subsoil.

The simplest and cheapest method of surface drainage is by shallow ditches that follow the low depressions through the field. The best locations for the ditches can readily be determined by the farmer after a heavy rain, when the water is standing on the ground. The ditches can be made at any time when the men and teams are not engaged on other work. In this manner the low spots in the field can gradually be brought into cultivation so that in a few years and with a small outlay of cash the farmer can put his land in much better condition as far as surface drainage is concerned. The benefits received from such work will more than repay the labor and cost involved. However, such drainage is effective only for removing the surface water quickly and making the fields cultivable sooner than would otherwise be possible. To drain the soil itself, it is necessary to dig numerous and comparatively deep open ditches, or to construct underdrains.

FIELD DITCHES

Field ditches are of two kinds, namely, narrow ditches with nearly vertical sides, and V-shaped ditches with flat slopes. The narrow ditches are used in regions where large machinery is not used extensively in farming, and cutting the land into small fields does not interfere to any great extent with farming operations. The V-shaped ditches are more desirable in regions where farming with large machinery is practiced, as they can be crossed with such equipment and their presence does not interfere so greatly with farming operations. The land occupied by both types can not be cultivated and where numerous ditches are required the area lost to cultivation is considerable.

DITCHING WITH MACHINERY

Where the ground is comparatively free from stumps and rocks and sufficiently dry to afford a footing for teams, an ordinary plow and a slip scraper can frequently be used in constructing shallow field ditches such as are required for surface drainage. However, if there is much of such work to do it is generally advisable to use one of the smaller types of ditching plows (fig. 2), which cost from $65 to $125. With such plows, V-shaped ditches from 2 to 2½ feet deep can be dug economically, the plow being pulled by horses or by a tractor and drawn back and forth until the ditch has reached the maximum size the plow will construct. In addition to digging ditches, such plows can be used for building terraces and grading roads.

An elevator grader digs ditches rapidly. By using an extension on the carrier that delivers the earth, ditches up to 6 feet in bottom width, 4 feet deep and with side slopes of 2 horizontal to 1 vertical can be built.

Large capstan plow ditchers (fig. 3) are manufactured that dig ditches from 3 to 3½ feet deep with a bottom width of 18 inches and a top width of 4 feet, up to 4 or 5 feet deep with a bottom width of 4 feet and a top width of 12 feet. Such ditchers are pulled by a tractor or by 10 to 12 horses hitched to a cable running from the plow through a series of pulleys to a deadman placed ahead in the line of the ditch. They vary in cost from about $700 to $1,500. Such ditchers operate successfully where the ground is free from stumps and rock and is practically level or has a uniform slope, but where the ground is irregular it is difficult to obtain a satisfactory grade. Unless a farmer has a large amount of flat-land ditching to do, the purchase of such a machine is not advisable. Instead, it

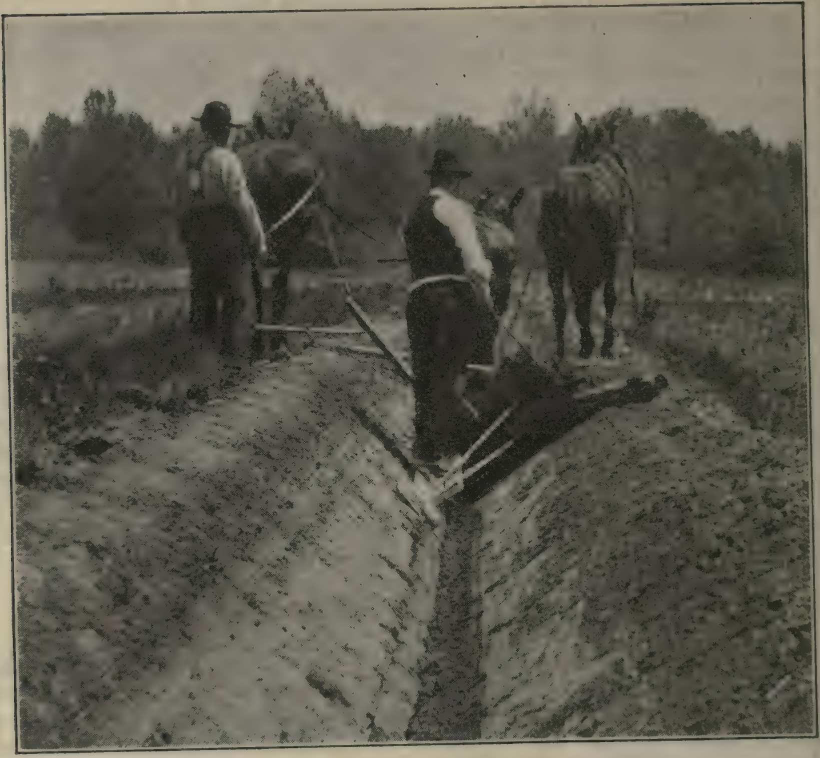

FIGURE 2.—Small ditching plow

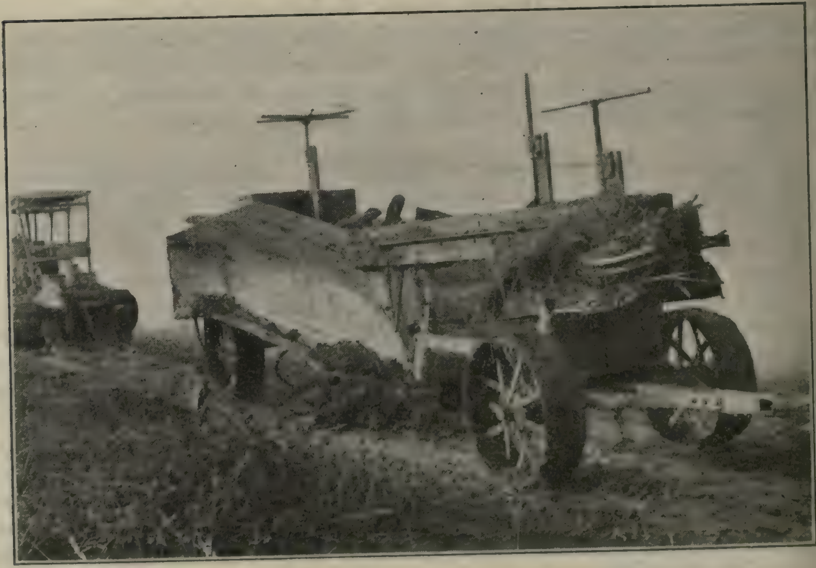

FIGURE 3.—Large capstan plow ditcher

is usually cheaper to engage some drainage contractor who is equipped to do the work.

There are a number of different types of machines designed for constructing large ditches such as usually are required for drainage-district outlets. Detailed descriptions of these machines can be found in another bulletin.[2]

DITCHING WITH DYNAMITE

While ditching with dynamite is possible under almost any conditions, it usually is economical only for making small ditches or cut-offs in stream channels, in soils other than gravel and dry sand. The most economical size of dynamite ditch is about 3 feet in depth and 8 feet in top width; much larger ditches can be built in this manner but the cost per cubic yard of excavation increases rapidly with the size. The ideal material for dynamite ditching is a saturated sedimentary soil that is firm but not as stiff as the hardest clays and is free from stumps and large roots. Many excellent ditches have been blasted under conditions quite different from these, but at increased cost. Where conditions are such that the work is adapted to any one of the several types of ditching machines, it generally is not advisable to use dynamite, but usually it is much cheaper to dig ditches with dynamite than with hand labor.

To blast a ditch with dynamite, a number of small charges are placed in a series of holes along the center line, for a ditch less than 10 feet wide and in two or more rows for wider ditches, and are exploded by one of two methods. In the "propagated" method the charges are so closely spaced that the detonation of one will explode the others. In the "electric" method the charges are connected to an electric blasting machine and all are discharged simultaneously. The first method usually has the advantage of being cheaper, but it can only be used in wet soils. With the electric method the charges are more certain to explode, and therefore this method is sometimes the more economical on account of the saving in time and labor.

There are two kinds of dynamite in general use for ditching, the straight or nitroglycerin, and the extra or ammonia. Both are made in several strengths, designated by percentages, and equal percentages indicate equal strengths as between the two kinds. For explosion by the propagated method, 50 per cent or stronger straight dynamite must be used, while for the electric method the 40 per cent strength of either kind is used. The "extra" dynamite is usually from 1 to 2 cents per pound cheaper than the same strength of straight dynamite, and the 40 per cent strength of either kind is likewise 1 to 2 cents per pound cheaper than the 50 per cent strength.

The size of the charges, the depth, and the distance apart depend on the conditions present in each case. For each size of charge there is some definite depth at which a broad, clean-cut, U-shaped ditch will result, and which will give the maximum amount of excavation per pound of explosive. When a charge is placed too deep for its strength, loose dirt will be left on the sides of the ditch, and when not deep enough the full power of the dynamite is not used.

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[2] YARNELL, D. L. EXCAVATING MACHINERY USED IN LAND DRAINAGE. U. S. Dept. Agr. Bul. 300, 59 p., illus., 1922. (Rev.)

The proper size and spacing of charges to give a clean-cut ditch of the desired depth must be determined experimentally for each set of conditions. This can best be done by firing a number of single charges, and when a size of charge is found which gives a smooth crater of the desired depth, a little less than the half diameter of the bottom of the crater will be the proper distance between charges, for the electric method. The proper distance between charges for the propagated method can be found only by trial. For a ditch 3 feet deep and 8 feet wide on top, in a saturated soil, it will be found that charges about as follows will be required: For the propagated method, 1 stick of 50 per cent straight dynamite, in holes 30 inches deep and 18 inches apart. For the electric method, 2 sticks of 40 per cent extra dynamite, in holes 30 inches deep and 30 inches apart.

The cost of ditch excavation by dynamite varies greatly. Under favorable conditions a pound of dynamite will blow out from 1 to 2 cubic yards of earth, making the cost for the explosive from 15 to 30 cents per cubic yard. Very little labor is required for such ditching. A gang of four men will load and shoot about 600 linear feet of single-row charges per day. It is usually necessary to remove débris and smooth the sides and bottom of the ditch with shovels after blasting. This work should be done as soon as possible, and if done promptly should not cost more than 1 cent per linear foot of ditch. This method is very useful for straightening streams.

Detailed directions for the handling, loading, and firing of charges for ditches can be obtained by addressing any of the manufacturers of explosives.

UNDERDRAINAGE

Underdrainage is the removal of excess water from the soil where the roots of the crops are to grow and find food for the plants. It is usually accomplished by pipes or covered channels, into which the water flows by gravity and through which it is carried and discharged into some lower natural or artificial drain.

Poles, brush, stones, and lumber have been used for underdrains, and when properly installed have provided fair drainage for a time. Usually, however, the length of time that such drains work well is short, for they become obstructed by the decaying wood or by an accumulation of silt.

In some localities, where the soil is a clay or clay loam, mole drains have proven satisfactory for short periods. Such drains are constructed by a mole plow (fig. 4), consisting of a short cylinder of iron about 4 inches in diameter with a sharp point, connected to a beam by a sharp shank about 4 feet long, made so that the distance of the cylinder or shoe from the beam can be varied from 2 to 4 feet. The plow is pulled along the course of the desired drain with the shoe at a depth of from 2 to 2½ feet. The cut made by the shank closes after the plow, while that made by the shoe remains open and acts as a drain. In rocky soils, or where stumps and other obstructions occur, this type of drain is not feasible. Neither is it feasible in loam or sandy soils. In clay or clay loam, mole drains have sometimes operated effectively for a number of years, but they can only be considered as a temporary expedient, and their use is not recommended under ordinary conditions.

The tile drain is undoubtedly the best underdrain. It consists of tile laid in the soil in a continuous line and upon such a grade that any water which finds its way into it will be carried by gravity to some lower point. The water enters the tile line through the joints between the tile, and not through the walls of the tile as many suppose. The walls of most porous tile will absorb water quickly until saturated, but no appreciable amount of water passes through the walls. Porous tile are no more efficient than impervious tile, and are very likely to be soft and easily broken or crushed. The movement of the water through the soil and into the tile is due to the action of gravity and not to a sucking or pumping action in the drains.

PLANNING A TILE DRAINAGE SYSTEM

The first essential for a tile drainage system is a suitable outlet. Without this the system will be a failure, no matter how carefully constructed. The outlet channel may be a natural watercourse, a large open ditch, a small field ditch, or another tile drain. It is important to select an outlet that is large enough to carry the flow reaching it without submerging the tile for too long a time during periods of heavy rainfall. The ideal outlet permits a free flow from main at all times.

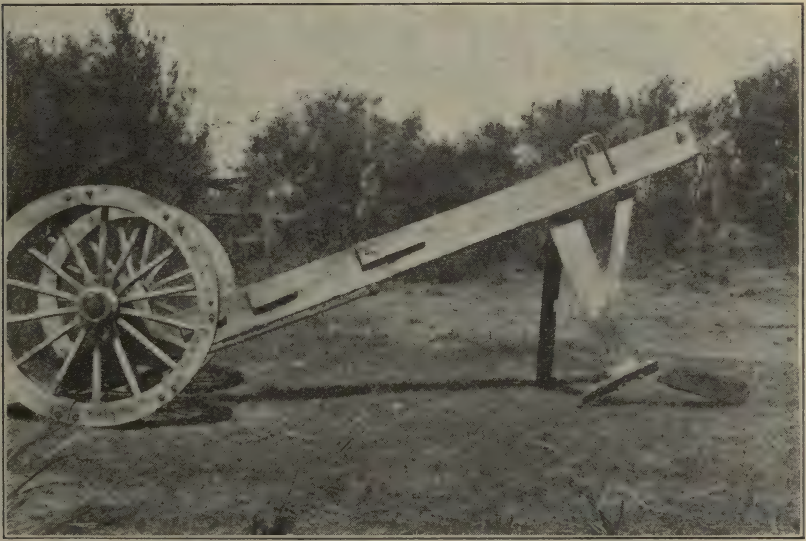

FIGURE 4.—Mole ditcher

In the majority of cases an adequate natural watercourse or drainage ditch is available to carry away the water discharged by the tile system. Often, however, an outlet channel must be provided before a system of underdrains that will operate successfully can be constructed. On extensive flat areas with limited natural drainage, the construction of outlet ditches frequently requires the cooperation of a number of interested landowners. A majority of the States have drainage laws that provide for such cooperation. Those laws usually provide for the organization of drainage districts having authority to construct and maintain outlet ditches or drains, and to assess each landowner within the district a share of the cost proportionate to the benefit he derives.

LOCATION OF DRAINS

The location of tile drains is controlled largely by the location of the outlet and the topography of the area to be drained. Where the land is more or less rolling, a farm may sometimes be thoroughly drained by laying random lines of tile where the soil is too wet for profitable cultivation. In such cases the drains should be located in the course of the natural flow, or so as to serve the portions of the field that are in particular need of drainage. Such a method of drainage, illustrated in Figure 5, is known as a random system.

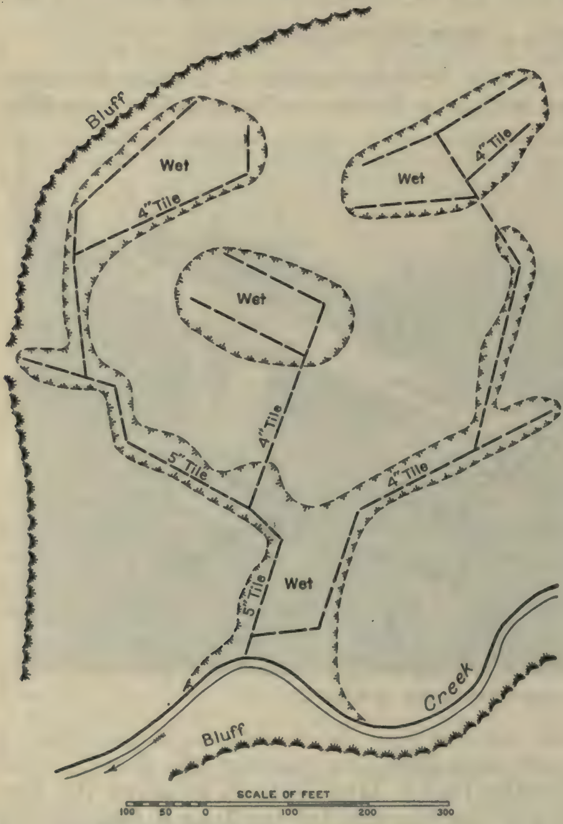

FIGURE 5.—Typical plan of random drainage

On land that is uniformly too wet for cultivation it is advisable to construct a complete system of underdrainage; that is, a system of main-outlet drains with parallel lateral drains under the whole area. Such a system is shown in Figure 6. In general, the main drains should follow the courses taken by the surface water in passing off the land during periods of heavy precipitation. The laterals should be straight and run in the general direction of the greatest slope; they should be arranged in groups of parallel lines laid at such intervals and at such depths as the soil requires. A system of short mains with long laterals is most economical, as the mains drain the land for a certain distance on each side and the laterals through this drained belt serve only to conduct the water to the mains. One main should serve as many laterals as possible to keep the number of tile outlets at a minimum, for outlets always require more or less attention if the drains are to operate efficiently.

Where entire fields would be benefited by underdrainage and the landowner does not have sufficient money available to construct a complete system, it is frequently possible to drain parts that need it most with a random system and leave the balance of the work until a later date. The results obtained from the drains first installed can be carefully studied and the location of additional drains needed can be determined. In constructing a random system in this manner it is necessary to keep in mind the requirements of the complete system, that the random lines shall be large enough and deep enough to take the discharge from the future laterals. By proceeding in this manner the maximum profits will be received from the money expended, and the increased returns from the drained land can be expended in completing the improvement. Figure 6 illustrates a comparatively level field to be drained first by random lines of tile designed to be used as the mains in a complete drainage system to be constructed later.

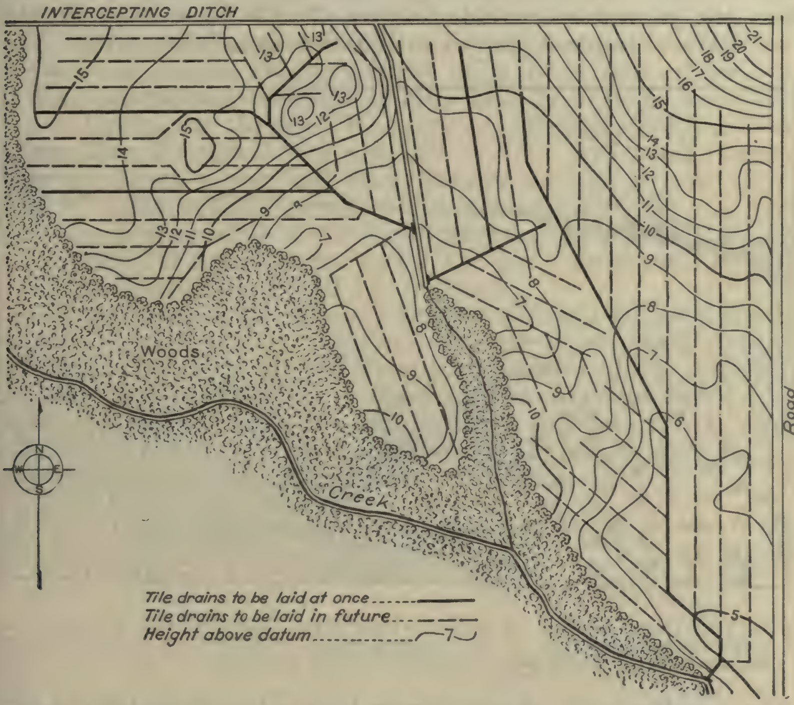
INTERCEPTING DITCH
Woods
Creek
Road
N
E
S
W
Tile drains to be laid at once
Tile drains to be laid in future
Height above datum
7

FIGURE 6.—Random drainage system with provision for complete drainage to be installed later

When the area to be drained is of considerable size and nearly level, it is always advisable to employ a competent drainage engineer to make a survey of the area and locate and stake out the drains. Where the land has plenty of fall and the areas to be drained are small it is frequently possible for the landowner to locate the drains during wet periods, and to construct them at such times as the general farm work permits.

DRAINING SEEPY HILLSIDES

Wet areas along hillsides usually are caused by an impervious layer of soil that stops the downward flow of the water, so that it is discharged on the surface at a point near where the subsoil comes to the surface, and the soil is thus kept too wet for cultivation. This condition can be corrected by laying a tile drain above the line where the ground becomes wet, and deep enough to intercept the water flowing along the top of the impervious layer, as shown in Figure 7. The drain should run across the slopes as nearly parallel to the seepy place as possible.

DEPTH AND SPACING OF DRAINS

The proper depth of drains and their distance apart are determined largely by the texture of the soil. The ground-water level is lowered between drains in a curved line, the highest point being midway between the drains. The spacing and the depth should be such as to reduce the ground-water table between the tile lines to an elevation most beneficial to plant growth within 24 hours after a rain.

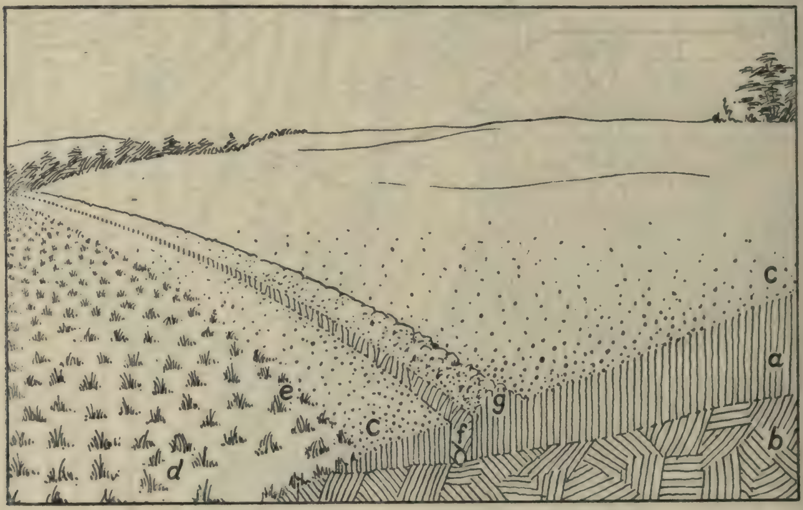

FIGURE 7.—Proper location for an intercepting drain. *a*, porous soil; *b*, impervious strata; *c*, cultivated land; *d*, wet or seeped ground; *e*, edge of wet ground; *f*, intercepting drain; *g*, waste bank of trench excavated for drain

The rapidity with which a drain lowers the ground-water curve depends upon the ease with which water percolates through the soil. The amount of coarse sand in the soil is one of the elements affecting the rate of percolation of water. In sandy lands the drains may be placed deeper than in clay lands, and accordingly may be spaced farther apart. The presence of "joint clay" formation in the subsoil is a great help to under-drainage as the water will follow the joints. In tight clay soils the movement of soil water is very sluggish, and underdrains must be placed at less depth and closer together than is the case in soils with a more open texture.

In general it can be stated that in clay soils it may be necessary to place drains from 40 to 70 feet apart and from 27 inches to 3 feet deep. No tile should be laid less than 27 inches deep, that is, the bottom of the trench on which the tile is laid should be at least 27 inches below the ground surface. In the more open soils, such as sandy loam, it may be sufficient to space drains 80 to 200 feet apart and from 3 to 4 feet deep. A spacing closer than 50 feet makes drainage so expensive that it usually is not recommended unless the land is to be used for trucking or some other type of crop from which the returns are large.

SIZE OF TILE

The size of tile for the main and submains of a tile system are determined largely by the area drained, the surface conditions, the porosity of the soil, and the grade or fall available for the drain. The required capacity of a drain is nearly proportional to the acreage from which the water comes, other conditions being the same. An area from which all the water must be removed by the underdrains will require larger tile than one which has good surface drainage, because surface channels carry off a large part of the water during a storm and underdrains then have to provide for only the part that seeps into the soil. Water passes through an open soil more rapidly than through a close soil; hence, water will reach the drains faster through a porous soil than through one that is relatively impervious. The capacity of a tile line increases with the rate of fall along the drain, being about twice as much at a fall of 4 inches in 100 feet as at 1 inch in 100 feet. Therefore the greater the grade or fall the smaller the size of tile required.

Four-inch tile is the smallest size that should be used for land drainage. Smaller sizes are more difficult to lay accurately, and are much more easily clogged by a small amount of silt getting into the line. A 4-inch tile has fully twice the carrying capacity of a 3-inch tile, and the difference in cost is not sufficient to warrant the risk involved in using the smaller drain. Table 1 shows the comparative capacities of different sizes of tile lines.

TABLE 1.—*Comparative capacities of tile*

One	Will carry the discharge of
5-inch	Two 4-inch.
6-inch	Three 4-inch, or one 5-inch and one 4-inch.
8-inch	Six 4-inch, or two 6-inch or three 5-inch.
10-inch	Eleven 4-inch; or one 8-inch, one 6-inch, and one 5-inch.
12-inch	Eighteen 4-inch; or one 10-inch, one 8-inch, and one 4-inch.

Experience indicates that where no surface water is admitted to the underdrains, tile systems in ordinary loamy soils generally should be designed with sufficient capacity to remove one-fourth inch depth of water over the area drained in 24 hours. In some of the more pervious soils that permit the water to pass through rapidly, such as very sandy loose loams, it is advisable for the drains to have a capacity of three-eighths inch depth of run-off per 24 hours. When surface water is admitted to the underdrains, as through surface inlets, the size of the tile should be increased so as to carry a run-off of three-fourths inch to 1 inch per 24 hours.

Table 2 gives the area in acres from which one-fourth inch of water will be removed in 24 hours by various sizes of tile laid at grades ranging from five-eighths inch per 100 feet to 12 inches per

100 feet. When three-eighths inch run-off is to be provided, two-thirds of the areas given in the table should be used. Where surface inlets will admit large quantities of surface water, the tile will give drainage to but one-fourth of the areas stated in the table.

TABLE 2.—*Areas from which one-fourth-inch run-off per 24 hours can be drained by tile mains*

[Table compiled from diagram of discharge curves for tile based on the Yarnell formula $V=138\,R^{2/3}\,S^{1/2}$]

Size of tile (inches)	Fall per 100 feet							
	⅝ inch or 0.05 foot	1¼ inches or 0.1 foot	2⅜ inches or 0.2 foot	3⅝ inches or 0.3 foot	4¾ inches or 0.4 foot	6 inches or 0.5 foot	9 inches or 0.75 foot	12 inches or 1.0 foot
	Acres drained							
4	—	6	9	12	14	15	19	22
5	8	12	17	21	25	28	34	40
6	13	20	28	35	41	45	56	64
8	31	43	62	75	87	98	120	138
10	55	79	110	138	158	177	215	250
12	90	128	180	220	255	280	345	410

Experience indicates that when small size tile drains are laid at minimum grades their length should be limited to those given in Table 3.

TABLE 3—*Limit of length of tile lines at minimum grade*

Size of tile	Minimum grade	Limit of length
Inches	*Feet*	*Feet*
4	0.10	2,500
5	.07	3,000
6	.05	3,600

SELECTING TILE

Draintile should be circular in cross section and approximately straight. The inside should be smooth, and the ends should be regular and smooth enough to admit of making close joints. Tile smaller than 10 inches in diameter should have a length of 12 inches; large tile may be 18, 24, or 30 inches in length according to the size.

Good tile should be free from visible grains or masses of lime or other minerals that cause slacking or disintegration; a broken surface should show a uniform structure throughout. The tile should be free from chips or cracks that would decrease the strength materially, and when dry they should give a clear ring if stood on end and tapped with a light hammer.

In constructing tile drains it is very important to use tile that have sufficient strength to withstand the pressure to which they are subjected, and that can withstand the action of the chemicals in the soil water that flows through them. The American Society for Testing Materials has prepared specifications for draintile, and it is good practice in making purchases to stipulate that the tile furnished shall meet the requirements of those specifications. For sizes smaller than 12-inch, the quality termed " farm " drain tile are sufficient for the usual conditions of draining farm lands; larger sizes should be of the " standard " quality. The specifications cover both clay and concrete tile.

CLAY TILE

Clay draintile are classified as either common or vitrified tile. The former are made from common brick clay which, when well burned, makes a good quality of building brick. The vitrified tile are made of ground shale or of a high grade clay, frequently mixed with common clay, and in some instances are salt glazed. They are stronger and less porous than the common clay tile and are usually more resistant to frost action. Either kind, when well made, is satisfactory for farm drainage.

CONCRETE TILE

Concrete tile have been extensively used in the Middle West. When properly made they have proven satisfactory in soils where acids and alkali salts are not present. Such tile must be made of clean sand and gravel, properly mixed and cured. To make good concrete tile proper equipment and careful supervision by men experienced in such work are required. The making of tile on the farm by using molds or small hand machines is usually not advisable as proper facilities for making and curing are not available. Concrete tile should be purchased from a factory that is well equipped and is known to be making a good quality of tile. Where the soil or ground water contains acids or alkali salts, special investigation should be made to determine the quality of tile required to resist the effects of those chemicals.

CONSTRUCTING THE TILE DRAIN

HAND TOOLS

The tools most commonly used in trenching and laying tile by hand are tile spades, shovels, drain scoops, and the tile hook. (Fig. 8.)

The tile spades are of two kinds—solid and open—and are from 16 to 22 inches long; the 18-inch and 20-inch sizes are most used. The open spade is used in digging mucky or sticky soils. The shovel used is of the ordinary long-handled, round-nosed type. The drain scoop is semicylindrical in shape and is fitted with a long handle; it is made in sizes to fit tile from 4 to 8 inches in diameter. The tile hook is made of ½-inch round iron—the long part being 9 inches and the short part 4 inches in length—fastened to an ordinary rake handle.

ESTABLISHING GRADE

When using inexperienced labor, probably the best method of establishing grade is that of gage and line. This method consists of stretching a cord at a uniform height above the bottom of the trench to be dug, and measuring down from the cord with a gage stick, as illustrated in Figure 9. The cord should be placed high enough above the bottom of the trench so that it will not interfere with the workmen.

The trench is marked out by stakes set 50 feet apart. At each 50-foot station there are two stakes, one with its top about level with the surface of the ground and known as a "grade hub," the other standing a foot or more above the ground and called a "guard stake." All measurements are made from the top of the grade hub. The guard stake locates and gives the number of the hub; upon it may be marked the required depth of the trench below the top of the hub. The gage for measuring to the bottom of the trench is usually a stick 1 by 2 inches. For ordinary farm tile work, an even 6 feet is a good length.

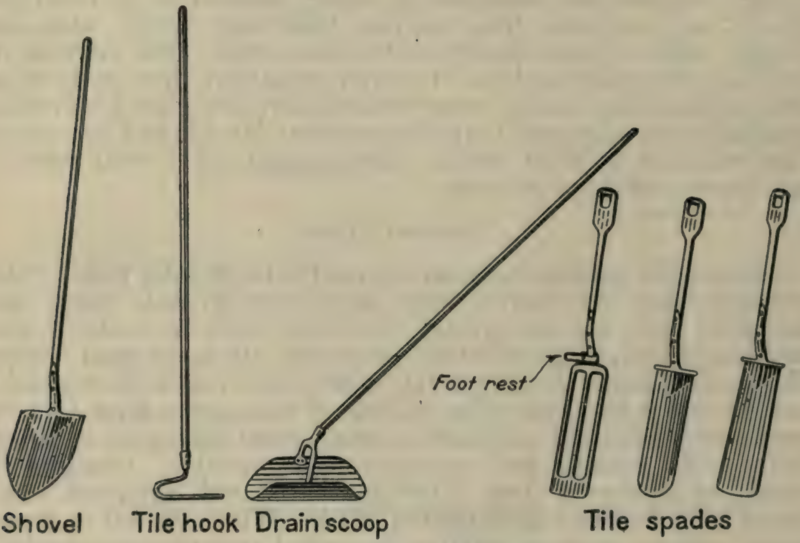

FIGURE 8.—Tile-drainage tools

To dig the trench to the proper grade, proceed as follows: Drive a strong stake upright near the hub and another on the opposite side of the trench, as shown in Figure 9. Across the trench place a bar with its top edge above the hub at a height equal to the difference between the length of the gage and the depth of cut at that station. The crossbar should be set level by the use of a carpenter's level. A convenient way of fastening the crossbar to the uprights is by means of clamps as illustrated. Set similar crossbars at three or more stations, and over the center line of the trench stretch a light, strong cord (preferably fishline), taut across the tops of the bars from one station to another. If the fall is uniform, any error in establishing grade can be detected by sighting over the crossbars. The trench bottom is at correct grade when the gage is stood upright in the trench and its top just touches the grade cord. The bottom of the gage must be kept clean, as any adhering dirt will result in incorrect grade.

In Figure 9 a cut of 3 feet, 11 inches is indicated at the hub in the foreground. Subtracting this cut from the length of gage (6 feet), the difference of 2 feet, 1 inch is the height for setting the top of the crossbar above the top of the hub. The gage in the foreground indicates that the trench has been dug to proper grade at that point.

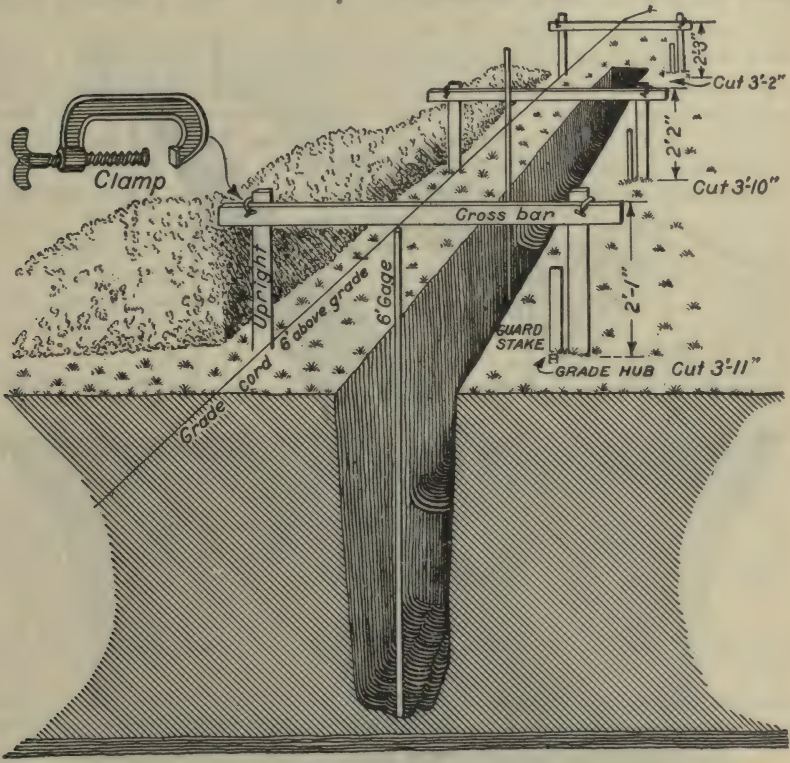

FIGURE 9.—Crossbar method of establishing grade for a tile drain

The other gage indicates that further digging is required, the amount being shown by the length that the gage extends above the cord.

A slightly different method of obtaining proper grade, widely used by experienced tile layers, is shown in Figure 10. A gage about 5 feet long is used, and instead of crossbars, white chalk lines are stretched across the trench, held in place by wooden stakes or iron rods. The height of these lines above the hubs is, as before, the difference between the depth of cut and the length of the gage used. Three or more of these chalk-line "targets" should be used at a time. The grade is determined by sighting over the top of the gage and the lines. If these line up, the trench is at grade; if the top of the gage projects above the line of sight established by the targets, the trench is not deep enough; if the top of the gage drops below the line of sight, the trench is too deep. Usually it is more convenient to sight down rather than up the completed trench. However, when starting from the outlet, as in Figure 10, or when passing a point where the grade changes, it is necessary to sight upstream until the next station is passed.

IMPORTANCE OF CORRECT LEVELS

Attention is called to the importance of having no sags in a completed tile drain. Any depression is likely to cause a settling of silt in the tile, which will result in partial or even total obstruction of the drain. Where the available fall is slight, the determination of the levels upon which the construction work is based must be done accurately. For this reason it is advisable that these preliminary levels be determined with an engineer's level where practicable, and that one of the foregoing methods of establishing grade be used. The less the available fall, the greater the necessity for accurate work.

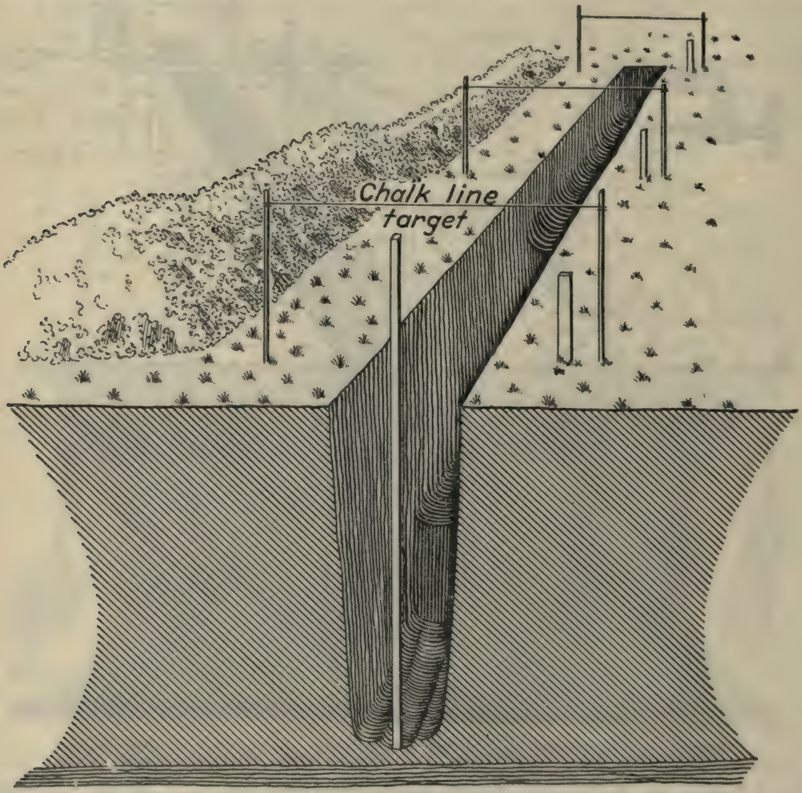

FIGURE 10.—Target method of establishing grade for a tile drain

When the fall is 3 inches or more per 100 feet, fairly good results can be had by establishing the tile grades with an **A** frame used in connection with a carpenter's level. Such a device is shown in Figure 11. The legs ab and bc may be of 1 by 4 inch lumber, 12 feet long. The distance ac is 16 feet 6 inches (1 rod). The brace upon which the level rests should be absolutely straight and so set that when the legs of the frame rest on a perfectly level surface the level bubble is at the center of the tube. Any desired fall can be obtained with this device by nailing a block upon the bottom of one leg; a 1-inch block as shown in Figure 11 will give a fall of 1 inch per rod. Care must be taken to see that no dirt adheres to the bottoms of the legs, as this will seriously affect the grade.

DIGGING THE TRENCH

Trenching should always begin at the outlet and proceed upstream. For small tile, trenches are usually dug 10 to 15 inches wide, according to the depth, and with practically vertical sides. The trench is dug with a tile spade to within 1 or 2 inches of grade, and then the bottom is cleaned out to grade with the drain scoop. Standing in the trench ahead of the tile that have been laid, the workman draws the scoop toward him, leaving the trench bottom smooth and rounded to fit the lower part of the tile. Care should be taken not to excavate below grade.

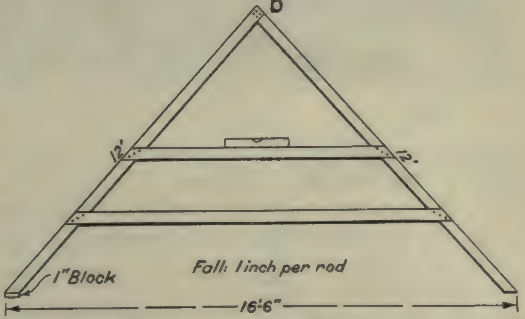

FIGURE 11.—Homemade A-frame level for use in constructing drains

TILE-TRENCHING MACHINES

Where the amount of work to be done is large and labor is scarce it is frequently advisable for the landowner to purchase some form of tile-trenching machine or to have the drains constructed by a contractor who has such a machine. The cost of trenching by machinery is not greatly different from that by hand labor. The main advantages of machine work over hand labor are that fewer men are required and that the work is completed more rapidly.

Tile-trenching machinery may be divided into two general classes—horse-drawn trenching plows and power-operated trenching machines. The ditching plows are comparatively inexpensive implements (costing from $20 to $500), which will excavate trenches suitable for smaller sizes of tile. (Fig. 12.) They can frequently be used to advantage in digging the top 18 inches or 2 feet of the trench. However, hand labor is necessary to dig the trenches to grade after such plows have been used. Power-operated trenching machines are of two general types, wheel excavators and endless-chain excavators; those generally used in farm drainage cost from $3,500 to $4,500. Figure 13 shows a wheel excavator in operation. A detailed description of power-trenching machines can be found in another bulletin.[3]

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[3] YARNELL, D. L. TILE-TRENCHING MACHINERY. U. S. Dept. Agr. Farmers' Bul. 1131, 22 p., illus., 1923. (Rev.)

LAYING THE TILE

Tile laying, like trenching, should begin at the lower end or outlet and progress upstream, following closely the excavation of the trench. In placing the tile, they should be turned until the ends fit together tightly. If a tile is crooked or the ends are irregular it should be turned until it fits tightly at the top, the open space being left at the bottom. Where, owing to irregular ends, a crack or opening of one-fourth inch or more must be left at the top or sides, it should be covered with pieces of broken tile, strips of tar paper or, in some sandy soils, with cement mortar.

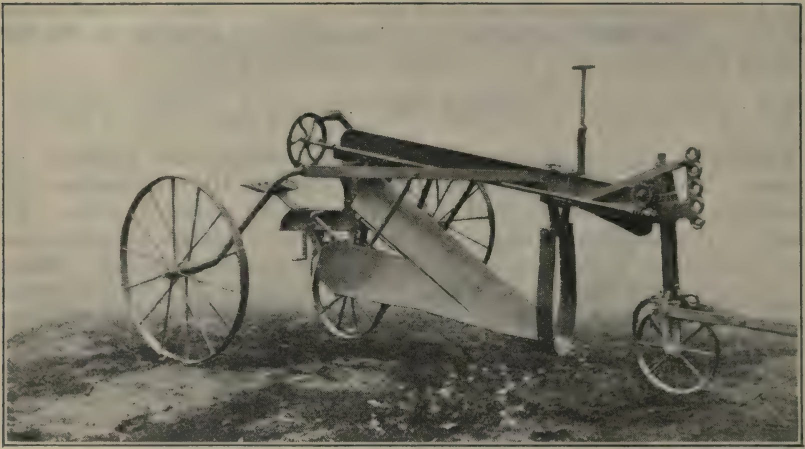

FIGURE 12.—Trenching plow

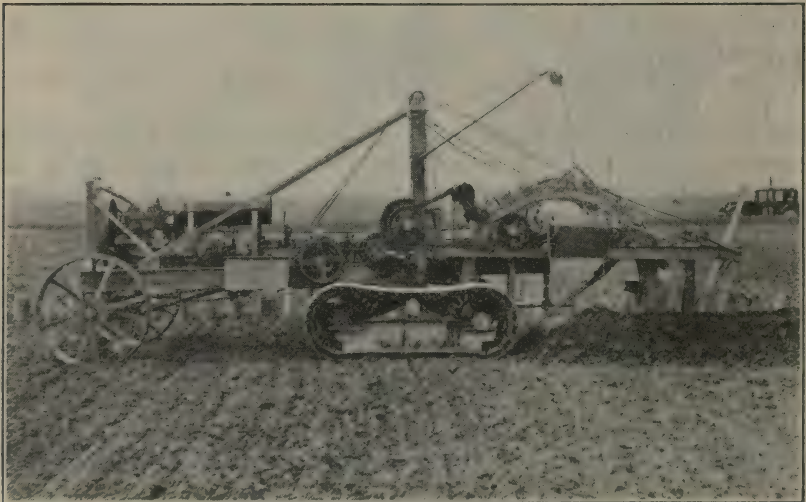

FIGURE 13.—Wheel-type trenching machine

Tile up to 6 inches in diameter can be placed either with a tile hook by a man on the trench bank or by hand by the man who is finishing the trench with the tile scoop. It has been found that with unskilled labor the best results are obtained if the man using the tile scoop works backward up the trench, laying the tile as fast as he finishes the grade.

If the trench has been dug below grade in dry materials, the bottom can be built up to grade with moist earth, well tamped. In a wet, soft trench it may be advisable to lay the tile on plank bedded at grade. Where saturated fine sand or sandy loam is encountered, it is necessary to prevent the soil from washing into the tile through the joints, by wrapping the joints with cloth or tar paper. In laying tile through quicksand it is well to have the assistance of a man experienced in such work.

All tile that are cracked, soft, or poorly-shaped should be laid aside; these tile are not wasted, unless there is an excessive number of them, as it is necessary to have broken tile to patch junctions and poor joints. It is very important that the tile be laid and "blinded" (see page 20), as soon as the trench is completed to grade. This is necessary as otherwise caving of the banks and softening of the bottom may occur. The end of the tile line should be closed whenever the workmen leave the job, to prevent dirt getting into it; and when completed each line should be closed at its upper end by a brick or piece of broken tile.

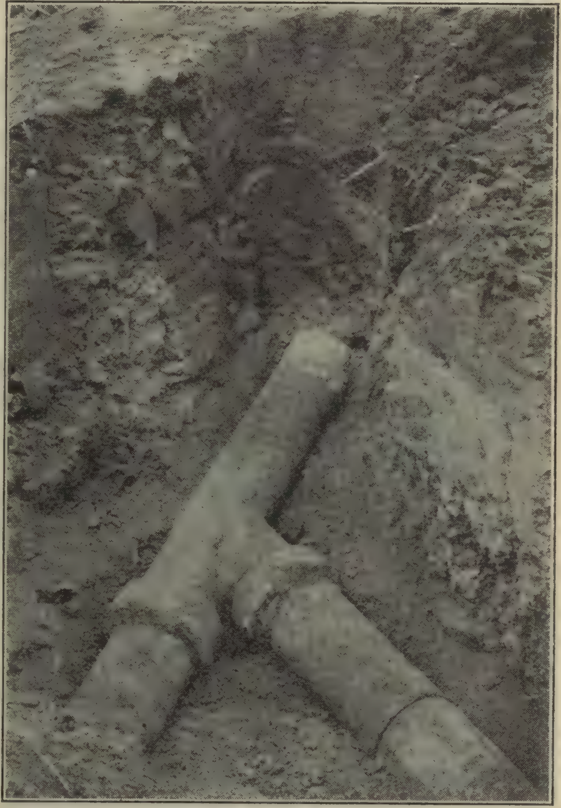

FIGURE 14.—Tile junction

MAKING JUNCTIONS AND CURVES

Junctions should be made by Y's (fig. 14) not by T's nor by elbows. Practically all tile factories now make junction tile, and these should be obtained if possible. If Y's can not be obtained, junctions can be made by cutting and fitting together straight tile. When this is done care must be taken to prevent the branch tile from projecting into the main. Unless the lack of fall prevents, there should be a drop from the branch into the main, which can be obtained by turning the Y slightly in its bed so as to elevate the branch.

Changes of direction should be made by curves and not by sharp angles. These curves should be regular, with the outside of the joints covered by pieces of broken tile (fig. 15), or, for a sandy soil, the ends of the tiles can be chipped off on the insides of curves with a hammer or by catching the tile between the jaws of a monkey wrench and bearing down on the handle.

BLINDING THE TILE

The tile should be covered the day they are laid, with loose earth to a depth of 4 to 6 inches, so that they may be held in place. This should be done carefully in order not to displace the tile.

BACK FILLING THE TRENCHES

Trenches should be filled soon after the tile are laid. For this purpose a plow can be used with two horses, one on either side of the trench, attached to a long evener. One side is plowed while going in one direction, and the other side on the return trip; usually two rounds of the plow are sufficient to back fill a ditch. A scraper made from a 2 by 12 inch plank, 4 feet long, can be used to good advantage in many cases. The horses in this case work at right angles to the trench, scraping in the earth piled on the bank. If this method of back filling is to be used, it is advisable to throw all the earth dug from the trench on one side rather than on both sides. Road-grading machines can also be used for back filling trenches.

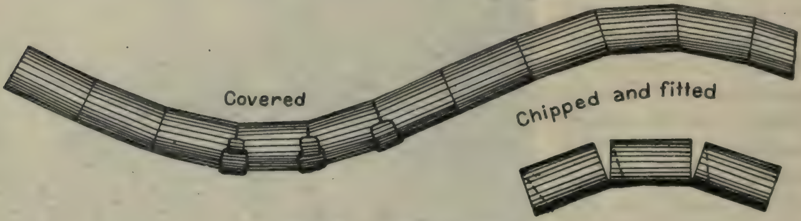

FIGURE 15.—Curves in tile line

PROTECTING THE OUTLET

The outlet end of a tile drain should be protected by a head wall of brick, stone, or concrete. If not more than 4 feet high, the head wall should be 16 inches thick and should extend from the ground surface to at least 1 foot below the bottom of the ditch in front of the head wall. For higher walls the thickness should be increased proportionately. A typical head wall is shown in Figure 16. Tile outlets are often damaged by washing out and caving unless protected in a substantial manner. The joints of the first 10 feet next to the head wall should be cemented. Where freezing occurs, the first 10 feet of drain should be of vitrified pipe or second-grade sewer pipe. A cushion of concrete or stone should be built in front of the outlet to prevent the water from undermining the head wall.

Burrowing animals such as muskrats and rabbits often obstruct tile drains by entering at the outlet and building nests in them. Where this trouble is likely to occur, it will be well to hang a screen over the end of the drain as shown in Figure 16. A screen permanently fixed over the outlet catches trash washed down the drain, especially in systems where surface inlets are used. Ordinarily, surface water which follows the depression over the tile line should be diverted so as not to discharge over or around the head wall.

SURFACE INLETS AND SILT WELLS

The purpose of the surface inlet is to admit surface water directly into the drain. The office of the silt well is to catch and retain any silt suspended in the water. These two devices are often combined in one structure. The surface water enters through the top, while the drain water enters through the tile at one side and flows out at the other. Two or more lengths of sewer pipe set on a concrete base make a satisfactory surface inlet, or a concrete-box inlet may be built. (Fig. 17.) At the top should be placed an iron grating, which may be covered with broken brick or small stones to act as a coarse filter. From time to time the brick or stone should be rearranged and the silt removed from the bottom of the catch basin. If only a small amount of surface water is to be handled, a satisfactory inlet can be made by filling a section of the trench with broken brick or tile, or with gravel, as shown in Figure 18. Under certain conditions the use of surface inlets will greatly increase the effectiveness of the drains, especially in heavy clay soils where percolation through the ground to the tile is naturally slow. They are seldom necessary in soils that drain readily, or that have a fair slope.

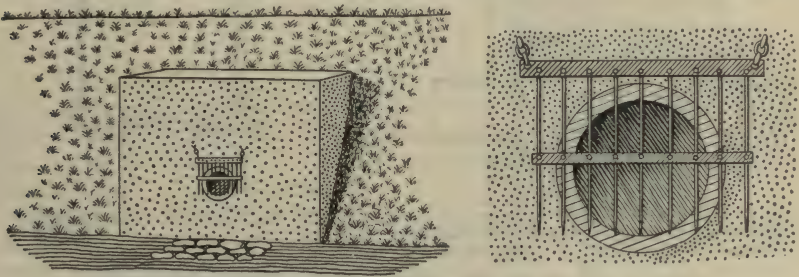

FIGURE 16.—Typical head wall for tile outlet

OBSTRUCTION OF DRAINS BY TREE ROOTS

Roots of trees growing in the vicinity of tile drains may penetrate the drains and obstruct the flow, especially if the tile is fed by springs or carries water far into the dry season. Under such conditions roots enter the joints of the tile in search of moisture, and masses of roots grow until they sometimes completely fill the tile. This occurs with other varieties as well as with those classed as water-loving trees. If the water ceases to flow in the tile as the surrounding land dries out, the drain in all probability will not be obstructed by tree roots. Where there is reason to suspect that this difficulty will be encountered, the joints of the tile should be tightly cemented. As a general practice, all willows and other water-loving trees growing within 50 feet of a tile drain should be destroyed.

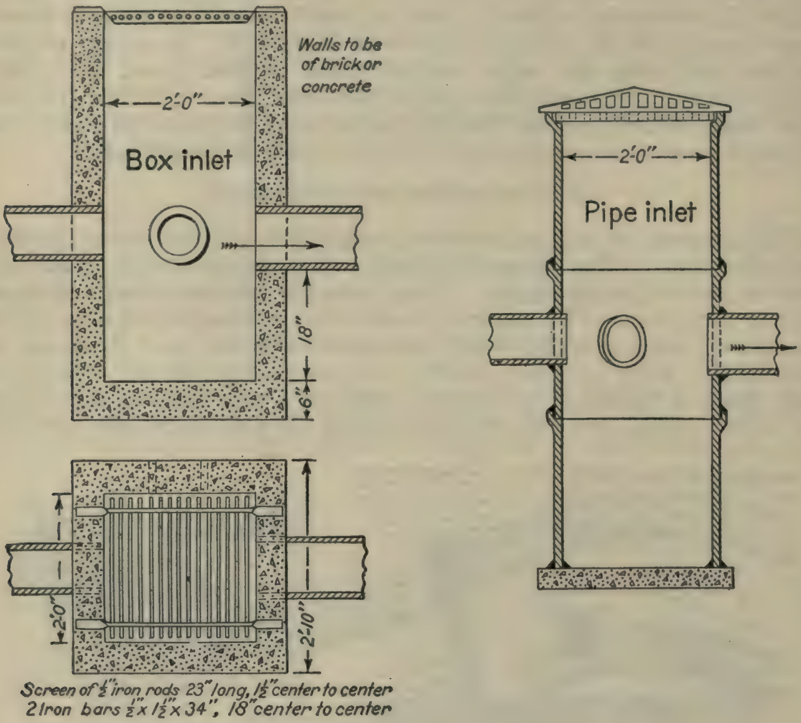
Walls to be of brick or concrete
2'-0"
Box inlet
18"
6"
2'-0"
2'-10"
Screen of ½" iron rods 23" long, 1½" center to center
2 Iron bars ½" x 1½" x 34", 18" center to center
2'-0"
Pipe inlet

FIGURE 17.—Design for combined surface inlet and silt well

DRAINAGE RECORDS

A permanent record should be kept of the locations and depths of all drains. To this end all maps, plans, and profiles of the system built and notes relating to it should be preserved. Wherever a tile line crosses or ends at a fence, farm road, or other permanent line, iron stakes or pieces of pipe should be driven in order that the drain may be easily located. The importance of this will be seen when it is desired to extend or repair drains, or to add branches.

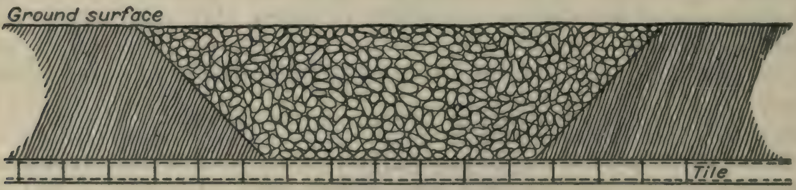

FIGURE 18.—Blind inlet

COST OF TILE DRAINAGE

The cost of tile drainage varies greatly, depending upon the prices paid for the tile; the transportation expenses from factory to farm, including hauling and distributing the tile along the line of the drain; the cost of labor to dig the trenches, lay the tile, and back fill the trenches; and the length of drain needed.

The prices of tile vary with the section in which it is manufactured, being lowest in the Middle West where tile drainage is extensively practiced and where competition between tile factories is strongest. Most factories sell tile by the thousand feet. In the Middle West the prices prevailing in 1929 for tile at the factory, loaded for shipment, are about as shown in Table 4.

Table 4.—*Weights and prices of draintile in the Middle West, 1929*

Size of tile	Weight per foot	Price per 1,000 feet in carload lots
Inches	*Pounds*	*Dollars*
4	7	20–22
5	9	28–30
6	12	37–40
8	20	55–65
10	27	105–120
12	37	145–160

The expense of transportation depends upon the distance tile are shipped, and the cost of hauling them to the farm and distributing them along the line of the drain. Often the farmer can do a considerable part of the hauling.

Digging the ditch and laying and blinding the tile are generally considered as one operation, which is usually done by contract at an agreed price per rod. This price is affected by the character of the soil, the depth of the ditch, and the size of the tile. An average price for 4-inch, 5-inch, or 6-inch tile laid 3 feet deep or less is 50 to 60 cents per rod. Eight-inch tile laid 3 feet generally costs from 75 cents to $1 per rod, and 10-inch and 12-inch tile laid 3 feet deep from $1 to $1.25 per rod. For deeper drains, the prices usually increase rather rapidly with the depth.

The cost of tile drainage per acre depends upon the amount of tile required per acre, as well as upon the price factors just mentioned. Where the land does not require a uniform system of drainage the cost may not exceed $10 or $15 per acre. Where uniform drainage is required the cost will depend largely upon the spacing between drains. Drains spaced 50 feet apart may cost from $60 to $70 per acre, whereas with drains 80 feet apart the cost probably would be about $45 to $50 per acre. The lengths of drain required per acre for laterals, given in Table 5, will aid in estimating the cost of a complete drainage system for any farm when the prices for tile and labor are known. The length of the mains, which will depend upon the arrangement of the drains, must be added.

TABLE 5.—*Length of tile per acre, for laterals only*

Distance between laterals *Feet*	Amount of tile required per acre *Feet*	Distance between laterals *Feet*	Amount of tile required per acre *Feet*	Distance between laterals *Feet*	Amount of tile required per acre *Feet*
40	1,089	65	670	90	484
45	969	70	623	95	459
50	872	75	581	100	436
55	792	80	545	150	327
60	726	85	513	200	218

VERTICAL DRAINAGE

By vertical drainage is meant the disposal of drainage water through wells into a porous soil layer or open rock formation that is capable of taking large volumes of water rapidly and in turn has outlet lower than the land to be drained. The existence of such a substratum, at a depth that can be reached without prohibitive cost, is the exception rather than the rule; and usually there is no way of foretelling whether its capacity as a drainage outlet is sufficient to be permanently effective. In the limestone regions of the United States where considerable areas have natural drainage into the "sink holes" that are more or less common, such wells can frequently be used advantageously where outlets into natural or artificial watercourses are not easily accessible, but in general the possibilities of drainage in this manner are very limited.

Drainage wells must be lined, except through rock, to keep earth from falling in and clogging the outlet. The tops, also, must be protected against the entrance of trash and sediment. The cost of such wells has many times been $90 to $200 per acre, which is much more than the assessments for outlet drainage in most drainage districts. Therefore the installation of drainage wells is not recommended where a surface outlet can be obtained at a reasonable cost, except in those unusual cases where it is certain that vertical drainage is feasible.

MAINTENANCE OF FARM DRAINS

Any drain that is to operate efficiently must be kept clean. Tile drains with good outlets, if properly constructed, rarely become clogged. The condition of the soil along a drain a few days after heavy rains always indicates how the drain is working. If wet spots occur, the water is not being carried off properly. A hole or cave in above a tile line indicates that a tile has been either broken or displaced. When this occurs, immediate steps should be taken to repair the line; otherwise the entire drain above the clogged part may become filled with silt, making it necessary to relay that part of the line.

Open ditches and the outlet channels for tile drains and the lower end of the tile lines should be inspected frequently, and all weeds, grass, briars, willows, silt, trash, or refuse of any kind that obstructs the flow of water should be removed. If this is done at frequent intervals the cost is comparatively small, but if the drains are allowed to deteriorate the cost of repairing them or redigging the ditches may equal the cost of the original improvement. The maintenance of drainage improvements is an excellent example of the adage, "an ounce of prevention is worth more than a pound of cure."

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October 1, 1929

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THE NEMATODE DISEASE OF WHEAT AND RYE

By R. W. Leukel, *Associate Pathologist, Office of Cereal Crops and Diseases, Bureau of Plant Industry*

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INTRODUCTION

THE NEMATODE DISEASE of wheat and rye is caused by the nematode or eelworm, a very tiny worm technically known as *Tylenchus tritici* (Steinbuch) Bastian. It is slowly spreading in the wheat-growing areas in the southeastern United States. A number of reports of infestation have been received from districts hitherto thought to be free from the disease. It seems desirable, therefore, to bring to the attention of those interested the main facts concerning the disease, particularly the description, cause, grains attacked, geographic distribution, manner of spread, losses, and control measures. It is hoped that this information will be of assistance in recognizing and eradicating the disease where it now occurs and in thus preventing its further spread.

DESCRIPTION OF THE DISEASE

GALLS IN GRAIN

The presence of the nematode disease in wheat usually is discovered by finding the hard dark galls in the threshed grain. These galls often are mistaken for cockle seeds, vetch seeds, smut balls, bin-burnt kernels, ergot bodies, or other substances commonly found in threshed grain. (Fig. 1.) But cockle seeds are easily distinguished by their spiny coat and characteristic shape, vetch seeds by their smoothness, uniform color, and roundness, smut balls by their black, dusty contents, fishy odor, and the ease with which they can be crushed between the fingers, and bin-burnt kernels and ergot bodies by their general shape and cross section. Some of these differences are illustrated in Figure 1.

The nematode galls from wheat are from one-eighth to three-sixteenths of an inch in length and from one-sixteenth to one-eighth

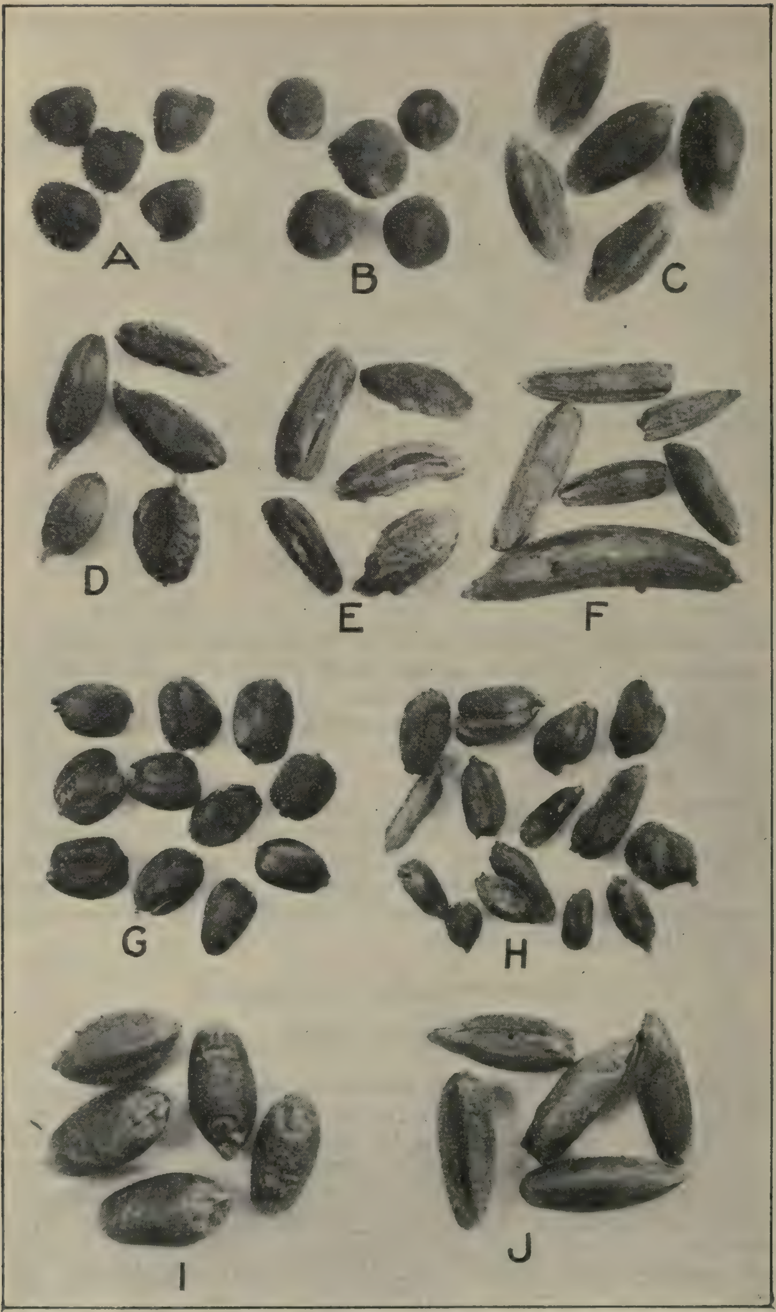

FIGURE 1.—Comparison of nematode galls from wheat and rye with normal kernels of wheat and rye and with impurities commonly found in threshed grain. (Enlarged three times.) Note the comparative uniformity in the size and form of the galls from wheat and the variation in the size and form of the galls from rye. A, Cockle seed; B, vetch seed; C, bin-burnt wheat kernels; D, bunt balls; E, ergot sclerotia from wheat; F, ergot sclerotia from rye; G, nematode galls from wheat; H, nematode galls from rye; I, wheat kernels; J, rye kernels

of an inch in width, on the average. They are rather dark in color, with light-brown tips, and usually are grooved somewhat like a wheat kernel. Many galls vary from the average in size and shape, so that sometimes it is difficult to recognize them. Galls from emmer and spelt are identical in size, color, and shape with those from wheat, but galls from rye, as a rule, are smaller, relatively longer, and lighter in color. Galls from certain varieties of spring wheat also are slightly different in shape and color.

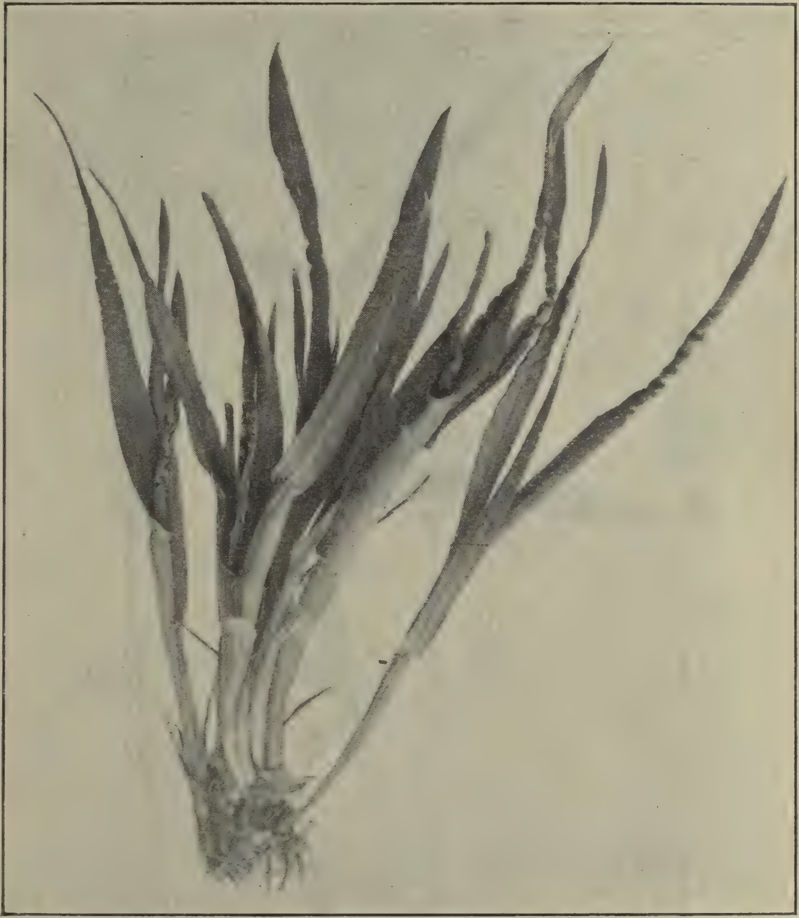

FIGURE 2.—Wheat seedlings attacked by nematodes. Note the wrinkled leaves with curled edges and the emerging leaves tightly rolled

SEEDLING SYMPTOMS

If seed containing nematode galls is sown, or if clean seed is sown on soil infested from a previously diseased crop, many of the seedlings will show the rolling, twisting, curling, or wrinkling of the leaves and other plant distortions characteristic of the disease. (Fig. 2.) The rolling or curling of a leaf often cramps the next emerging leaf, causing it to become badly distorted, as is shown in Figure 3. The stem often is enlarged near the base; frequently it is bent, and usually it is more or less stunted. In some plants only one or two culms may be affected, while in others all or nearly all may be diseased.

As the plant approaches maturity the earlier symptoms become less evident unless the culm is very severely diseased, in which case it either dies before heading or bears a very imperfect and badly diseased head.

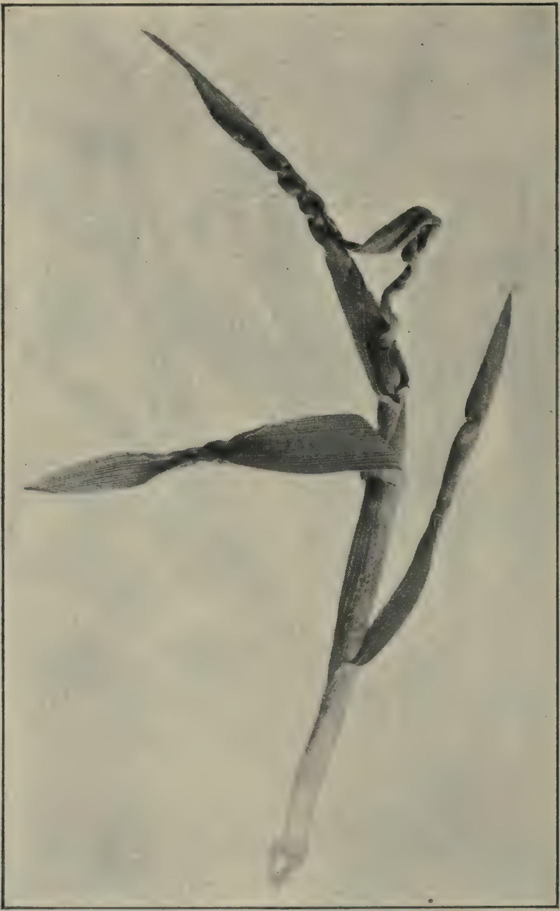

FIGURE 3.—Wheat seedling attacked by nematodes. Note the emerging leaf tightly held by the curling of the older leaf inclosing it

HEAD SYMPTOMS

Diseased heads usually are shorter and thicker than the healthy ones, and the glumes are spread farther apart by the nematode galls, which replace the kernels. (Fig. 4.) Frequently several galls are found in place of a single kernel. (Fig. 5.) At first these galls are shining and of a green color, but as the heads ripen, the galls turn dark brown or black in wheat, and straw colored in rye. Some heads contain only galls, while others contain both galls and kernels. It is not uncommon to find a single gall in an otherwise healthy head or a single sound kernel in a badly diseased head. Partially diseased heads often are hard to distinguish from healthy heads. Diseased heads remain green longer than healthy ones, and at maturity the glumes often assume a dirty brownish color. The galls shatter out of the heads more readily than the kernels, and during harvest many galls fall to the ground, thus infesting the soil for a subsequent crop.

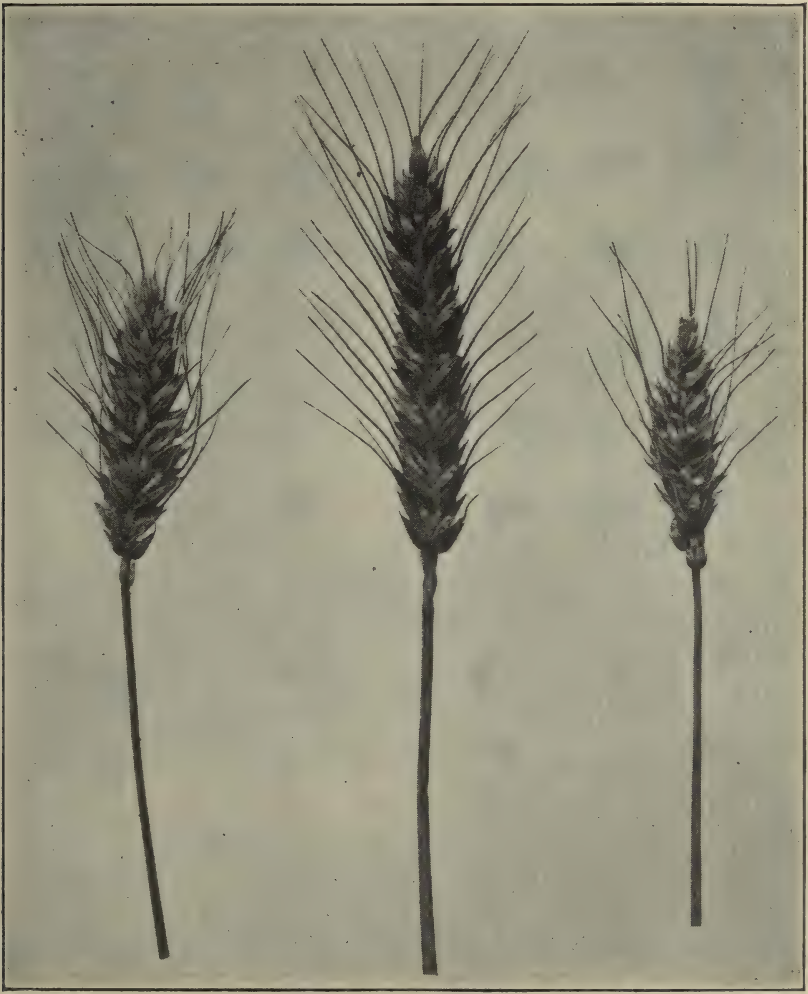

FIGURE 4.—Healthy head of wheat shown between two nematode-infected heads. In the diseased heads note the spreading chaff, the distorted awns, and the dark galls in place of normal wheat kernels. (About three-fourths natural size)

CAUSE OF THE DISEASE

The galls in the infested grain contain thousands of microscopic eellike worms called nematodes. A section much enlarged through a gall is shown in Figure 6. While inside of the dry gall these nematodes or eelworms are in a dried-out dormant mass, but if the gall is opened and the nematodes are placed in water they absorb moisture and become eellike in appearance, as shown in Figure 7. In a short time they start an active whipping movement.

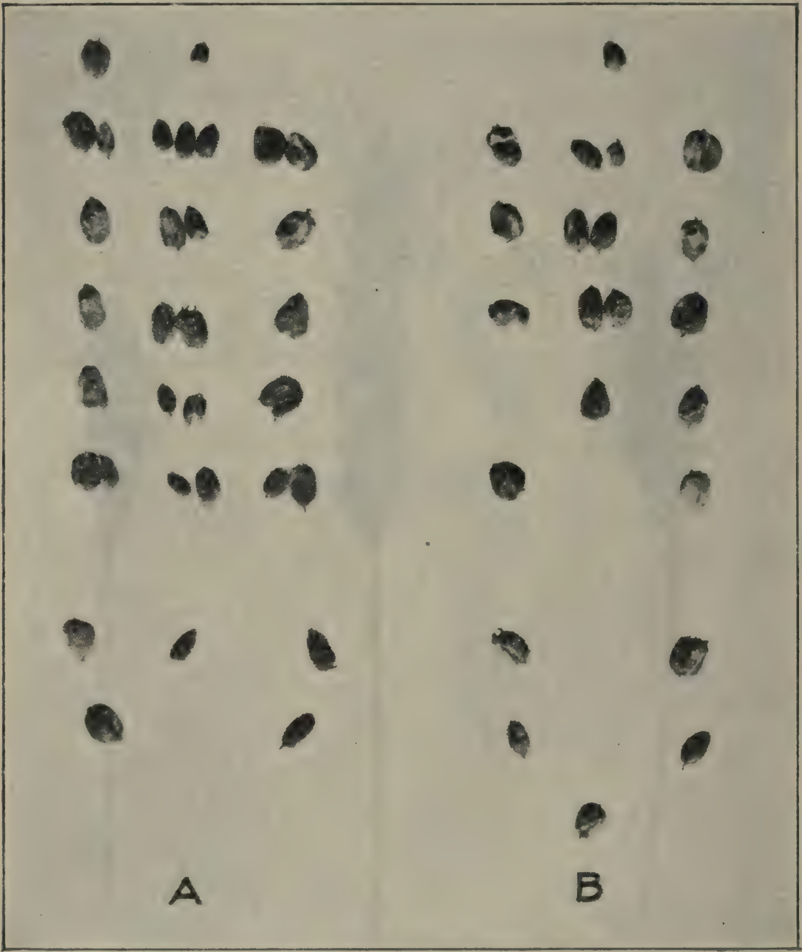

FIGURE 5.—Nematode galls from a head of Dietz wheat arranged as found in the different flowers of the spikelets (meshes or breasts). A and B, Galls from spikelets on the opposite sides of the same head

When nematode galls are sown with the seed, or have dropped to the ground from a previously diseased crop, the walls of the galls are softened by water and soon collapse, allowing the nematodes to escape into the soil. They get in between the leaf sheaths of the young wheat or rye seedlings and finally reach the growing point, where, without effort on their part, they are carried up by the elongation of the growing stem. They remain about the growing points until the grain heads begin to form. Then they attack the young developing heads and cause the formation of galls instead of normal flower parts. Within these newly formed galls the nematodes grow to be mature adults, male and female. They copulate, and the females lay eggs, after which the adults of both sexes die. The eggs hatch into young nematodes, which, at the maturity of the plant, go into the dried dormant state mentioned above. In this condition they have been found to remain alive for as long as nine years. If the galls were stored under conditions especially favorable for the nematodes, the latter might remain alive even longer.

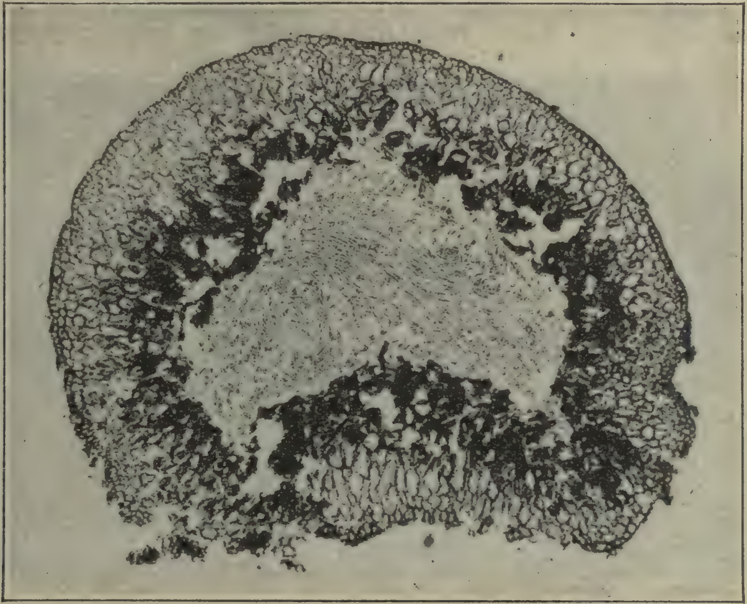

FIGURE 6.—Cross section of a nematode gall magnified 35 times, showing the thick wall surrounding the white mass of dormant nematodes in the center. When placed in moist soil the wall of the gall soon softens and the nematodes, revived by the absorption of water, escape from the gall into the soil where they attack the young wheat or rye seedlings

GRAINS ATTACKED

The nematode disease was originally discovered on wheat, but it also readily attacks rye, emmer, and spelt. Oats are attacked to some extent in the seedling stage, but in no case have mature galls been found on this crop. Barley may be classed as practically immune, although in one case a few small, imperfect galls were found in the heads of Hansee Hull-less barley, the seed of which had been heavily inoculated with nematode galls. Grasses, other than cereals, are not attacked, so far as known.

GEOGRAPHIC DISTRIBUTION

The nematode disease of wheat and rye is known to occur on every continent. The greatest losses have been reported from the countries of central Europe. In the United States it is known to occur at present in Maryland, Virginia, West Virginia, North Carolina, South Carolina, and Georgia. In 1909 it was reported also from California and New York, but since that time it has not been found in either of those States. It possibly may occur in other States where, up to the present, it may have been overlooked or mistaken for something else. In Wilkes County, N. C., the introduction of the disease was traced to shipments of seed wheat from Virginia. Therefore, it seems highly probable that shipments of infested seed may have carried the disease into other States from which it has not yet been reported.

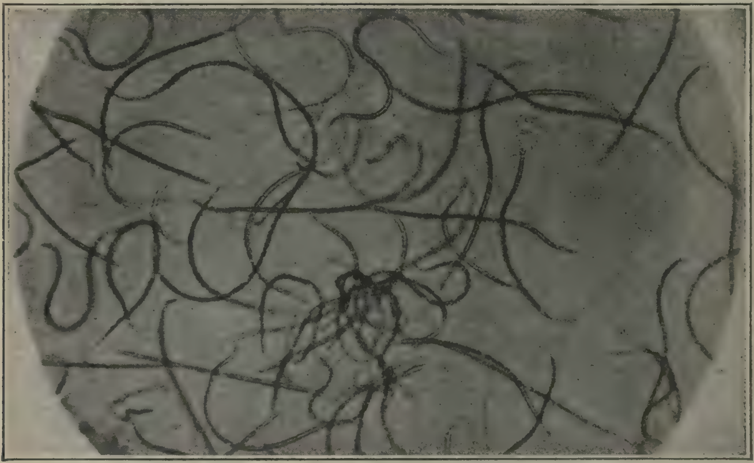

FIGURE 7.—Nematodes taken from a gall, placed in water, and photographed through a microscope which magnifies them about 30 times. In water the nematodes move actively with an eellike motion; therefore they are often called eelworms

Samples of plants thought to be affected with this disease, or of threshed grain thought to contain galls, should be sent for positive identification to the State agricultural experiment station or to the Office of Cereal Crops and Diseases, Bureau of Plant Industry, United States Department of Agriculture, Washington, D. C.

HOW THE DISEASE SPREADS

The chief and only important method of spreading the disease to any distance is by means of the galls in the seed grain. Straw from an infected crop also may spread the pest to distant fields, as many of the galls are blown into the straw at threshing time.

Within a given locality, the threshing machine often spreads the disease from one farm to another. This was shown to be true in one locality in particular where the disease was known to occur for years only on farms in a certain threshing ring.

In marketing grain, in the infested regions, the screenings removed from the wheat at the mill or elevator usually are taken back to the farm, where they are fed to stock. Experiments have shown that the disease is not spread to the fields by the manure of farm animals which have eaten galls, but by the uneaten galls in the litter. An example of this is shown in Figure 8. In this case chickens were fed screenings containing a high percentage of nematode galls. As chickens do not relish these galls, most of the galls remained uneaten and were later gathered up with the litter and spread by means of a manure spreader on a strip of land in a field which was later sown to winter wheat. In the spring it was observed that most of the wheat in this strip apparently had winterkilled. The few plants that survived were badly diseased and produced only galls in the heads.

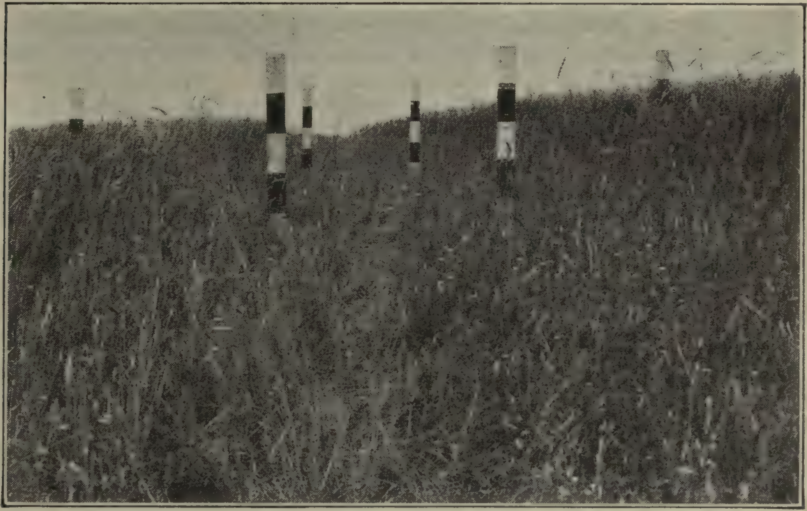

FIGURE 8.—A portion of a field of winter wheat showing where manure, badly infested with nematode galls in the litter, had been applied before sowing. All six stakes, similarly marked, were driven so that each projected 5 feet above the ground. In the center, where the infestation was most severe, the plants were either killed or badly stunted, as shown by the center stakes, 4 feet of which are visible, as compared with the outer stakes, which are almost hidden by the tall, healthy grain

Experiments have shown that, in the soil, the nematodes can travel by their own efforts only about 15 inches. Therefore, wheat or rye can be grown safely on clean soil fairly close to infested soil if cross cultivation is not practiced. However, heavy rains may wash some of the infested soil on to the near-by clean land and thus spread the nematodes. The nematodes can travel upward about a foot, so that deep plowing will not entirely eradicate the pest on infested land.

LOSSES DUE TO THE DISEASE

As the occurrence of the disease in the United States, so far as is known at present, is limited to six States, the loss it causes in wheat and rye, in the country as a whole, is relatively small. Nevertheless its possibilities are considerable, and therefore every precaution should be taken to prevent its spread.

Losses to individual farmers often are very severe. Estimates of losses on individual farms vary from a negligible amount to as high as 70 per cent of the crop. It is difficult to determine accurately the total damage in the ripe or threshed grain, because much of the injury is done in the seedling stage. Furthermore, many galls are blown out into the straw and screenings at threshing time. The most accurate way to determine the approximate loss in an infested field is to compare the yield per acre with that of a near-by uninfested field sown with the same seed, but uninfested, and under similar conditions of soil, fertility, drainage, etc. In this manner it has been found that, for two successive years, yields of infested rye were reduced 35 to 65 per cent, and yields of infested wheat were reduced 20 to 50 per cent, as compared with yields from the uninfested check plots. Spring wheat from infested seed yielded practically no grain, as almost every plant was badly infected and most of the heads contained only galls. From this experimental evidence it is safe to assume that the nematode disease would prove extremely destructive in a spring-wheat area.

CONTROL OF THE DISEASE

The nematode disease of wheat and rye may be readily controlled by using only clean seed and sowing it on uninfested land. No satisfactory resistant varieties of wheat or rye are known.

CLEAN SEED ON CLEAN SOIL

CLEAN SEED

Care should be taken to sow only adapted varieties of wheat or rye, free from nematode galls. If uninfested seed can not be obtained, or if it is desired to sow a particularly valuable lot of seed which is infested, the galls may be separated from the grain by floating them out in salt brine, or the nematodes in seed wheat may be killed by the modified hot-water treatment used for the control of loose smut.

The salt-brine method is as follows: Dissolve common salt in water at the rate of 40 pounds of salt to 25 gallons of water. A barrel or a small tank can be used for this purpose. After careful cleaning, pour the infested seed slowly into the salt solution, not more than a peck at a time, stirring vigorously at the same time. The nematode galls, light, worthless kernels, and trash will rise to the surface and float, while the sound kernels will sink. The former may be skimmed off with a strainer and disposed of as described later.

Some galls will be carried to the bottom with the grain. It should be stirred thoroughly and repeatedly, therefore, to give these galls a chance to rise to the surface. The salt brine, which can be used repeatedly, should be drained off and the grain thoroughly rinsed in fresh water. The rinsing in water must be thorough, as the salt will injure germination. After washing in water, the grain should be spread out on a floor or on canvas to dry. It should be stirred occasionally to hasten drying. After the grain is dry enough it may be sown at once or it may be more thoroughly dried and stored.

The skimmed-off material should be disposed of so that there will be no possibility of spreading the galls to land that is to be sown to wheat or rye that year. The safest method is first to rinse the skimmed-off material in water to remove the salt and then to plunge it into boiling water for a few minutes to kill the nematodes in the galls. After such treatment the material may be fed safely to chickens, hogs, or other stock, or thrown away.

The modified hot-water treatment as used for the control of the loose smut of wheat also kills the nematodes in the galls. This treatment consists of soaking the grain in water at ordinary temperatures for four to six hours and then in hot water at 129° F. for 10 minutes.

Where the disease occurs in the neighborhood, it is important to prevent its spread from farm to farm by means of the threshing machine. A threshing machine coming from an infested farm should be thoroughly cleaned, and the first lot of wheat or rye threshed should not be used for seed, as it is likely to contain nematode galls from the machine. Furthermore, it is advisable to thresh oats, barley, or some other crop before the wheat and rye.

CLEAN SOIL

Uninfested seed having been obtained, the next essential is to sow it on uninfested soil. Land which has just produced a crop of infested grain should be used for other crops for at least one year. Extensive field experiments have shown that the absence of wheat and rye, the susceptible grain crops, from the land for one year is sufficient to starve the nematodes in the soil. Clean wheat and rye may then be sown with safety on such land. Oats and barley are practically immune from attack and may be used in the rotation following wheat. In fact, any crop except wheat, rye, emmer, or spelt may be sown with safety so far as nematode injury is concerned.

Infested straw or infested manure and litter should not be put on land that is to be sown to wheat or rye unless it has been thoroughly rotted. The same holds true of stable manure from animals that have been bedded with straw from diseased grain. Experiments have shown that very few, if any, nematodes survive either passage through the alimentary tract of farm animals or prolonged decay in a manure pile.

RESISTANT VARIETIES

Numerous wheat varieties have been tested for resistance to the nematode disease, and only one variety, Kanred, has shown any appreciable degree of resistance. This variety, a hard red winter wheat, is not adapted to the southeastern United States.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

October 24, 1929

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THE OPERATION AND CARE OF THE COMBINED HARVESTER-THRESHER

By W. M. Hurst, *Assistant Agricultural Engineer, Division of Agricultural Engineering, Bureau of Public Roads*

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INTRODUCTION

THE HARVESTING AND THRESHING of grain were considered as separate and distinct operations until large-scale production demanded rapid and more economical methods. A machine was devised as early as 1828 for combining these operations, but was considered impracticable. Similar machines were built and tried out during later years but this method of harvesting did not become established until about 1880. From this date until about 1920 the use of the combined harvester-thresher, generally known as the combine, was confined largely to the States along the Pacific coast because it was believed that crop and weather conditions were unfavorable to its use elsewhere. The use of the combine has increased rapidly, and in 1928 it was used in practically all States where grain is grown extensively. From 1920 to 1928, inclusive, over 48,000 combines were sold in the United States.

With the customary threshing rig much of the threshing has been done by experienced operators who operated their machines primarily for custom work. With the combine, farmers are operating their own machines, thereby decreasing the cost of labor. In some cases the operators are inexperienced and have had considerable trouble with their machines. In many cases breakdowns and delays might have been avoided if proper precautions had been taken. Frequently the combine does a poor job of threshing and cleaning because the machine is not properly adjusted.

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[1] This bulletin is based on information secured in cooperation with the Bureau of Agricultural Economics, Bureau of Plant Industry of the United States Department of Agriculture, and the agricultural experiment stations of Texas, Oklahoma, Kansas, Nebraska, Montana, North Dakota, South Dakota, Minnesota, Indiana, Illinois, Pennsylvania, and Virginia.

The combine, as the name implies, cuts and threshes the grain at one operation. The sickle, reel, platform, and platform canvas are similar to those used on a binder or header. The threshing and separating parts are practically the same as those used on a stationary thresher. Combines vary in size from those which harvest a 35-foot swath of grain to those which harvest an 8-foot swath. A combine with a 35-foot cutter bar, when pulled at 2.5 miles per hour, will cut and thresh approximately 10 acres of grain per hour, while the 8-foot size, under the same condition, will cut and thresh approximately 2½ acres per hour. Under average conditions, of course, a machine will not harvest the maximum acreage per hour because of adverse crop conditions and necessary delays to permit oiling, adjusting, and repairing.

Power for operating the combine is usually supplied by an engine mounted on the machine. Some of the smaller combines are operated by a power take-off from the tractor, but this method is not entirely satisfactory because of lack of power under some conditions. When equipped with an engine the combine may be pulled by either a tractor or horses. The hillside types are equipped with brakes and a device for leveling the thresher to prevent the grain from accumulating on one side of the separator when it is operating on a hillside.

POWER AND FUEL

Table 1 shows the usual power requirements for operating combines of different types and sizes. However, the actual power requirements for a given-sized machine, whether tractor or horse drawn, depends largely upon the type and condition of the soil, topography, and crop conditions. Many operators use too large a tractor because it is the only one available. When the tractor is too small and adverse conditions exist, power may be supplemented by hitching on an additional tractor or a team of horses. For ordinary conditions, approximately one rated tractor drawbar horsepower is required for each foot of width of the cutter bar, provided the combine is equipped with an auxiliary engine. When the combine is operated from a power take-off a larger tractor is required than for the same sized machine equipped with an engine.

TABLE 1.—*The usual power requirements for harvesting with the combine*

Type of combine	Width of cut	Rated drawbar power of tractor	Horses required
	Feet	*Horse-power*	*Number*
Power take-off	8 to 10	15 to 18	----------
With auxiliary engine	9 to 12	10 to 15	6 to 10
Do	14 to 20	15 to 25	8 to 16

Studies have been made which show that a combine and tractor required approximately 1.4 gallons of fuel per acre of grain harvested[2] under conditions existing in the Great Plains States. Of this amount about 0.6 gallon per acre was used by the auxiliary motor.

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[2] REYNOLDSON, L. A., KIFER, R. S., MARTIN, J. H., AND HUMPHRIES, W. R. THE COMBINE HARVESTER-THRESHER IN THE GREAT PLAINS. U. S. Dept. Agr. Tech. Bul. 70, 61 p., illus. 1928.

DRY GRAIN ESSENTIAL

Ripe, dry grain is one of the first essentials for the successful operation of the combine. Green or damp grain not only interferes with the threshing and cleaning operations but has a decided influence on the market value and keeping qualities of the grain. Tough straw has a tendency to clog the machine by winding on the cylinder and other moving parts. Small particles of tough straw are difficult to remove from the threshed grain as the straw is much heavier when damp or green. The combine should not be started until the grain is dead ripe, which usually is 7 to 10 days after it is customary to begin harvesting with the binder. If the threshed grain feels damp or is easily dented with the finger nail the moisture content is usually too high for safe storage. The maximum moisture content of cereal grain for safe storage depends in part upon atmospheric conditions and storage facilities, but wheat which contains not more than 13 to 14 per cent moisture is considered dry.

OPERATION

Because of the wide variation in crop and harvesting requirements, it is impossible to give definite rules which will be adequate under all conditions; yet many difficulties may be overcome by following general rules.

STARTING A NEW COMBINE

Before starting a new combine the machine should be gone over thoroughly to see if all bolts and nuts are tight. Be sure no tools are left in the machine or on the platform canvas, as serious damage may result. Turn the cylinder and other moving parts by hand to see that everything is in good order and free to move. Be sure all chains and belts are installed correctly, as disastrous results have occurred when some parts of the machine were driven in the wrong direction.

A new combine should not be subjected to its working load until it has been run idle for several hours. Run the engine at low speed for an hour or more before throwing the combine in gear. Run the combine at about half speed for not less than two hours and at full speed for not less than two hours before starting the machine in the field. Examine the bearings frequently and keep them well lubricated. In case water in the radiator should accidently run low and the engine overheat, shut off the ignition and turn the engine over by hand while the radiator is being filled. Pour water into the radiator slowly as a cracked cylinder block may result from cooling the motor too quickly.

REEL AND PLATFORM

Ordinarily the reel should be so set that the slats, when in their lowest position, will strike 6 to 10 inches above and slightly ahead of the sickle. The exact position of the reel depends upon the height of the grain, quantity of straw cut with the grain, and the condition of the straw. The reel can usually be set so that the slats will push the cut grain well back on the platform.

For lodged grain the reel should be set lower and several inches ahead of the sickle. When the reel is set low, canvas belting is sometimes tacked on the outer edge of the reel slats to brush the cut grain back on the platform without danger of breaking the slats. In adjusting the reel, care should be taken to keep it parallel with the sickle. If the combine reel is set in the shape of a spiral the slats should first strike the grain at the outer end of the platform as this will tend to feed it head first into the machine. Special guards may be secured for some machines and attached to the combine platform to assist in elevating lodged grain.

If two reel sprockets are furnished, the low-speed sprocket should be used when the combine is pulled at a speed of about 2½ miles per hour or less unless the grain is badly lodged. The reel will frequently shatter some of the grain or throw heads over the platform if driven by the high-speed sprocket at this rate of travel. The high-speed sprocket should be used when the grain is lodged or the combine is pulled at a speed of more than 2½ miles per hour.

The loss of grain by the reel and platform is usually very small when small grain is harvested; but may be as high as 26 per cent when crooknecked varieties of grain sorghum are harvested,[3] if proper precautions are not taken. A large part of this loss is due to heads which hang on the reel slats and which are thrown to the ground either in front of or behind the platform. Such losses may be decreased by the use of additional boards, wire screen, or canvas, to increase the width of the reel slats. Wide reel slats may also be used to advantage when nodding varieties of small grain are harvested. It is often advisable to increase the height of the platform backstop by attaching a screen wire or canvas frame and by placing screen wire or canvas over the outer end of the platform when grain sorghums and nodding varieties of small grain are being harvested.

The extent to which the operator can control the height of cut is usually sufficient for most crops. This range varies but is usually from about 4 to 36 inches. Unless the straw is to be saved, the cutter bar should be operated as high as is possible without missing some of the heads. The cutter bar can usually be held at the desired elevation with only an occasional change unless the grain is very uneven in height. On some machines the platform may be raised by attaching strap-iron supports in a vertical position between the platform and its supporting members, thus increasing the maximum height of cut but leaving the range the same. Such changes are needed only for grain sorghum and tall sweetclover and should not be attempted unless recommended by the manufacturer, as some parts of the machine might be subjected to undue strain.

CYLINDER AND CONCAVES

The cylinder of each combine is designed to operate within a certain range of speed except under special crop and harvesting conditions. The speed of the cylinder is rated in revolutions per minute. The rating varies with the different makes and models of combines but is usually about 1,000 revolutions per minute, depending upon the diameter and type of cylinder. The rating is such that the tips of the cylinder teeth or corrugated bars travel at about 6,000 feet per minute when threshing small grain.

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[3] MARTIN, J. H., REYNOLDSON, L. A., ROTHGEB, B. E., AND HURST, W. M. HARVESTING GRAIN SORGHUMS. U. S. Dept. Agr. Farmers' Bul. 1577, 17 p., illus. 1928.

On some makes of combines corrugated bars are used on the cylinder and concaves, instead of teeth. The cylinder on this type of machine is usually run at a slightly higher speed than on the peg-tooth type.

The combine must not only cut and thresh the grain but should deliver it in a marketable condition. The proportion of foreign material and cracked grain affects the quality and grade of the grain and hence the price received for it. An improvement in quality may result in an increase of several cents per bushel in the price when the grain is sold on the market.

Dry and well-matured grain is usually comparatively easy to thresh and clean, but if it is very dry it may crack badly. Cracking is caused by the use of too many concave teeth, returning threshed grain to the cylinder with the tailings, improper concave setting, bent concave or cylinder teeth, excessive cylinder speed, end play in cylinder shaft, or too little clearance between cylinder and concave teeth. The kind and quantity of the tailings returned to the cylinder is an indication of the performance of the sieves, hence the tailings should be examined frequently. If very little threshed grain is being returned to the cylinder and cracking is evident, stop the machine and examine the cylinder and concaves for bent or loose teeth. It is usually advisable to use just enough concave teeth to thresh the grain from the heads and to keep the remaining teeth set low as the straw will not be chopped up so badly and the sieve will not clog so easily. The cylinder should be adjusted to provide uniform clearance between the concave and cylinder teeth. If cracking seems to be due to high cylinder speed, throttle the motor slightly below rated speed but not until other adjustments fail to produce the desired results.

Soybeans and grain sorghums are frequently cracked when the cylinder is run at rated speed regardless of the crop conditions and adjustments of the other parts of the combine. Throttling the engine in order to reduce the cylinder speed is not advisable because the speed of all other moving parts is reduced, the engine will not operate as efficiently, and the governor will not be sensitive to changing loads. Suitable pulleys, sprockets, or gears may be secured for some machines by which the cylinder speed may be reduced without throttling the motor or changing the speed of the other moving parts of the combine. This is usually accomplished by changing the gear or pulley ratio between the motor and cylinder, and by making a suitable change in sprockets on the cylinder shaft for driving the separating units at rated speed. The cylinder speed is usually reduced about one-half for soybeans and grain sorghums. That is, if the cylinder is rated at 1,000 revolutions per minute, for these crops the speed should be reduced to about 500 revolutions per minute. No changes in pulley or gear ratio should be attempted unless the necessary parts are recommended or furnished by the manufacturers.

Rye, oats, barley, flax, and emmer, (speltz), require approximately the same cylinder speed as wheat. Under ordinary conditions, when the rated cylinder speed is maintained, two rows of concave teeth are sufficient for barley, rye, oats, and emmer, as these crops are usually comparatively easy to thresh. Some varieties of barley, however, may require all of the concave teeth as the beards are difficult to remove from the kernels. The weather and condition of the grain govern the exact concave adjustment for any of these crops.

The concaves should usually be set high for flax since the seed is often difficult to remove from the bolls. Flax straw is tough and has a tendency to wind on the cylinder, especially if it is driven below rated speed.

Corrugated concave teeth may be used to advantage when harvesting alfalfa and clover. The concaves should be set high and the rated cylinder speed maintained. Sweet clover frequently piles up in the feeder housing, necessitating the employment of an extra man with a stiff broom to force the plants back to the cylinder.

Loss of grain caused by unthreshed heads in the straw is usually very small. However, tests made by collecting and rethreshing the straw show slightly more grain than tests in which only the threshed grain in the straw was recovered.

Poor threshing is invariably caused by improper concave setting, badly worn or bent concave and cylinder teeth, or too low cylinder speed. A speed indicator should be used for checking the cylinder speed as this is the only reliable method of determining the speed of a revolving shaft. If the cylinder is found to be running at rated speed and poor threshing is in evidence, stop the combine motor and examine the cylinder and concave teeth. Badly worn teeth not only cause poor threshing but increase the power consumption. In case poor threshing seems to be caused by the position of the concaves, raise them slightly. With tough grain it is sometimes necessary to use all of the concave teeth. In case some of the teeth have been previously removed, they should not be replaced until other adjustments fail to produce the desired results, as it is usually best to use as few teeth as will thresh all of the grain from the heads.

SEPARATOR

If threshed grain is carried out with the straw it may be because of an excessive cylinder and separator speed, an unduly strong air blast, or it may be due to overloaded straw agitators. Excessive separator speed tends to discharge the straw before the agitators have had sufficient time to shake out the grain. If the cylinder is found to be running at rated speed, decrease the air blast slightly by adjusting the wind gates. It is advisable to use as much air as possible without blowing the grain out, as more effective cleaning is secured. When a considerable amount of straw is cut it may be necessary to reduce the rate of travel or decrease the width of the swath.

FAN AND SIEVES

The quantity of foreign material in grain has a decided bearing on the grade and market value of the grain. Weed seeds, dirt, and trash must be removed ultimately. Effective cleaning often requires considerable skill but is usually under the control of the combine operator. Proper cleaning depends not only upon the adjustments of the sieves and fan but upon the effective operation of the entire machine.

It is advisable to use as much wind on the sieves as is possible without blowing the grain out. Oats, for example, are very much lighter than wheat and consequently require less wind. Adjustments for regulating the blast are provided for practically all conditions.

Small pieces of green weeds are very hard to separate from the grain. Tailings should be reduced to a minimum as the weeds will be chopped up into finer pieces each time they are returned to the cylinder. Every effort should be made to get the weeds out of the machine as quickly as possible. On some machines the tailings auger from the upper sieve may be covered with a board or a piece of sheet metal whereby the tailings are dumped back on the straw agitator rather than conveyed to the feeder house. Be sure that the machine is run at rated speed and that a sufficiently strong blast of air is supplied to lift the material as it passes over the sieves. If these precautions are not taken the weeds will tend to form a blanket over the sieves and will invariably choke the machine. It is usually advisable to miss some grain by operating with the cutter bar above the weeds if possible and to waste some grain by blowing it out of the machine rather than leave too many weeds in the threshed grain.

CARE OF THE COMBINE

MANUFACTURERS' INSTRUCTIONS

Combine manufacturers usually furnish a manual giving specific instructions as to the care and operation of their machines. This manual should be studied, as the information gained may result in a saving of time, labor, and grain.

REPAIRING

Successful combine operators appreciate the importance of getting the machine in working order before harvest time. If the machine is new it should be "broken in" as soon as possible, because if trouble develops, valuable time may thus be saved when the crop is ready for harvesting. Combines which have been used during previous seasons should be overhauled, repaired, and run for a short time several weeks before harvest actually begins. Some adjustments must be made in the field, but it is possible to have all of the parts in such condition that the necessary adjustments can be made quickly and accurately.

SPEED OF MOVING PARTS

Power from the combine motor or tractor is transmitted first to the cylinder shaft and thence to the other moving parts. All parts of the combine are so designed and connected as to operate at a speed which will give the best results under average conditions. This rated speed is usually given in revolutions per minute for the cylinder and should be maintained except under special crop or harvesting conditions. The operator should not guess at the speed but should use a speed indicator.

The cylinder speed should be determined when the combine is in operation by holding the indicator against the end of the cylinder shaft. If it is inconvenient to determine the cylinder speed directly, it may be calculated if the speed of any other shaft, driven directly by the cylinder, is known. For example, a fan shaft, which is driven by sprocket and chain from the cylinder, is found to be revolving at 500 revolutions per minute. Count the number of teeth on both the cylinder and fan shaft sprockets on which the chain is running.

Multiply the number of revolutions per minute of the fan shaft by the number of teeth on the fan-shaft sprocket and divide the product by the number of teeth on the cylinder sprocket. If there are 24 teeth on the fan-shaft sprocket and its speed is 500 revolutions per minute and 12 teeth on the cylinder-shaft sprocket the speed of the cylinder will be 1,000 revolutions per minute.

OILING

Before greasing a new machine, clean paint and dirt from all bearings and oil holes. On bearings using hard oilers force the grease in until it appears at the ends of the bearing. This forces out any dirt and insures complete lubrication of the bearing. Fill oil cups repeatedly until the space around the shaft is completely filled with oil. Manufacturers usually furnish printed instructions for the proper lubrication of their machines. These instructions should be followed, as the life of the machine depends in a large measure upon proper lubrication. Drive chains should not be oiled if sand or other abrasive substances are likely to accumulate on the chains. Chaff and particles of dust from the grain and straw are not abrasive.

BELTS AND CANVASES

When the combine is left standing overnight, exposed to the weather, remove the platform canvas and all belts or protect them from rain and dew. Old binders or headers canvases can be used to cover the combine canvases and belts or they can be removed and placed on the straw racks in the rear of the machine. If a tarpaulin is available, cover the entire machine. If the platform is held in position by springs it should be set in such a position as to relieve the tension on the springs when not in use. Straw and chaff should not be left in the combine as such material retains moisture and will cause the metal parts to rust. The greater part of the straw and chaff may be discharged by running the machine idle for a few minutes after finishing for the day.

HOUSING

Immediately after the harvest the combine should be cleaned thoroughly, both inside and out, and housed in a shed or barn under a good roof. Trash and dirt retain moisture and will cause metal parts to rust and wood parts to rot. All belts and canvas should be removed and protected from rodents. The machine, (exclusive of wearing surfaces), should be given a coat of paint, and the metal parts should be coated with a heavy oil. Linseed oil should be used on the wood parts only. While cleaning the machine inspect all parts and list the repairs needed. Such a list will be very useful in securing repairs and may save delay during the next harvest season.

If it is impossible to house the combine, remove all belts, and canvases and store them. Remove the reel and hang it up in a shed to prevent the slats from being broken or warped. Paint and oil the machine as described above. If a tarpaulin is used, tie it down in such a manner as to prevent the formation of pockets and low places where water will collect and eventually soak through and damage the machine.

ORDERING REPAIRS

When ordering repairs the make, model, size, and number, (if any), of the machine as well as the description, parts number, and quantity desired, should be given as the parts on different sizes and models are not always interchangeable. It is a good practice to give the date when the machine was purchased new as this will help to identify the model.

COMBINE ATTACHMENTS

Auxiliary equipment for the combine has been devised and used to meet some of the various harvesting conditions in different parts of the country. Such attachments are usually extra and may be secured for some machines if justified by harvesting and threshing requirements.

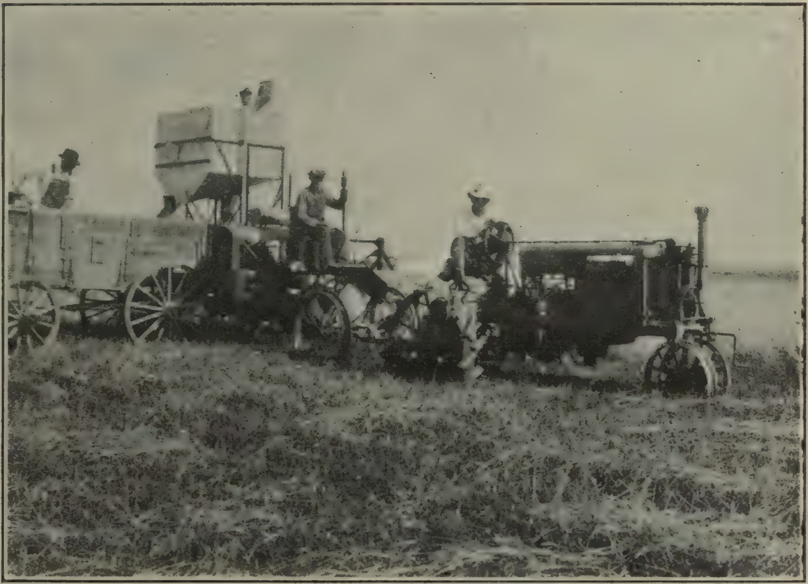

FIGURE 1.—Combine equipped with grain tank

GRAIN TANK, WAGON HITCH, AND SACKING ATTACHMENT

A grain tank, wagon hitch, or sacking attachment may be secured as desired for practically all machines. (Figs. 1, 2, and 3.) The grain tank for the larger machines usually holds about 65 bushels, whereas those for the smaller sizes hold 25 to 40 bushels. These tanks are emptied either by gravity or by an elevator and auger conveyer to a wagon or truck. When the wagon hitch is used, a wagon is attached to and drawn alongside the combine, and the grain is deposited in the wagon directly from the machine. In case the motive power is insufficient for both the grain wagon and the combine the wagon may be pulled as a separate unit. A sacking attachment may be used in lieu of either the grain tank or wagon hitch if desired. The sacking attachment usually consists of grain spouts and a platform with dumping device where the grain can be sacked and the sacks dumped on the ground.

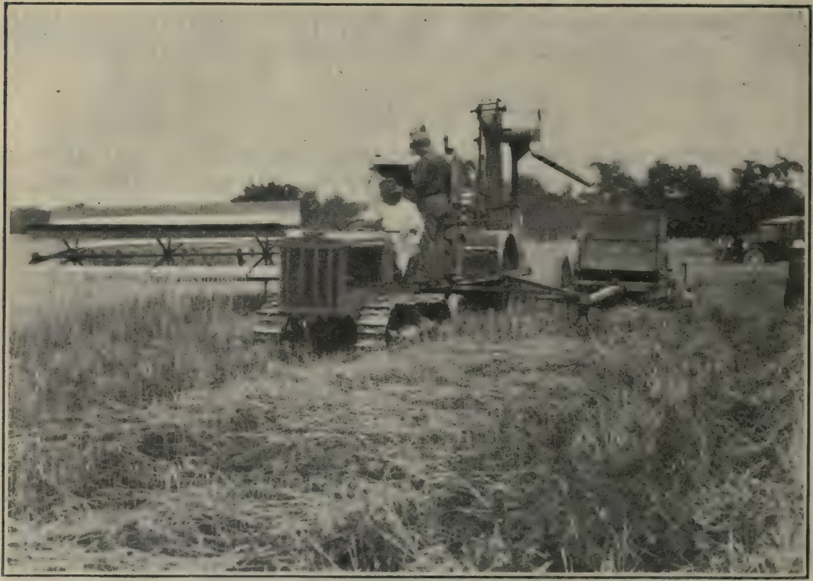

FIGURE 2.—Combine equipped with wagon hitch

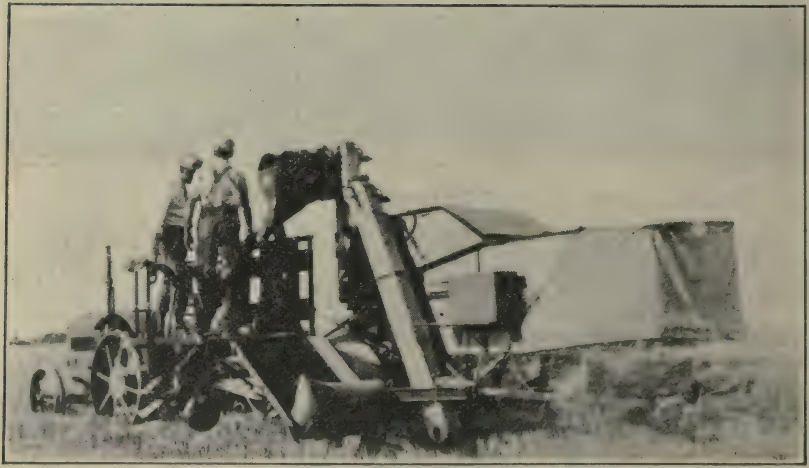

FIGURE 3.—Combine equipped with sacking attachment

PLATFORM EXTENSION

Most combines have sufficient capacity for handling a considerable quantity of straw. When the crop is light or very little straw is cut with the grain a platform and reel extension may be attached to the outer end of the platform to increase the width of cut. This equipment is attached directly to the platform and reel, but the original sickle is usually replaced by one of suitable length for the longer platform.

STRAW SPREADER AND BUNCHER

The straw spreader is generally used when the straw is not needed for feed or bedding, and it is desirable to have it scattered uniformly over the field. A straw spreader is shown in Figures 3 and 9. When it is desired to save the straw a buncher may be used which dumps the straw in piles. A straw buncher is shown in Figure 4. The straw from the buncher is usually dumped by a trip rope extending to the operator's platform. If the buncher should be overloaded, straw will accumulate in the separator, and clogging will invariably result. If neither the spreader nor buncher is used, the straw is left in windrows behind the combine and may be gathered with a hay loader.

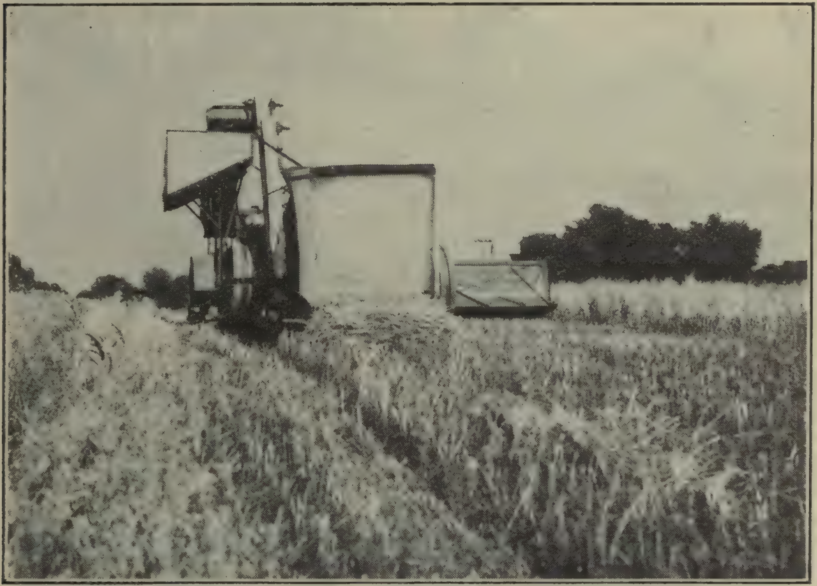

FIGURE 4.—Combine equipped with straw buncher

SPECIAL SICKLE

Figure 5 shows a special sickle which may be used for stationary work in cutting the heads from bundles of grain sorghum. The bundles of grain are hauled to the combine, or the machine is pulled from shock to shock and the bundles fed by hand. The heads of grain fall to the platform canvas, which conveys them to the cylinder, and the bundles of stover are pitched to one side to be used for feed.

SELF-FEEDER AND STRAW STACKER

When the combine is used as a stationary thresher a self-feeder and straw conveyor may be secured for some machines. The usual practice, however, when unbound grain is threshed is to remove the reel and use the platform as a feeder and attach the straw stacker to take care of the straw.

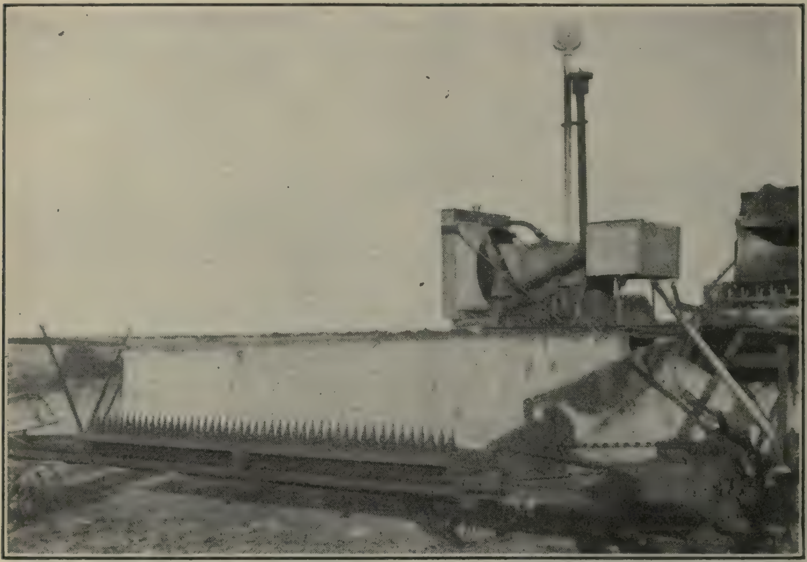

FIGURE 5.—Special sickle used for cutting heads from bundles of grain sorghum

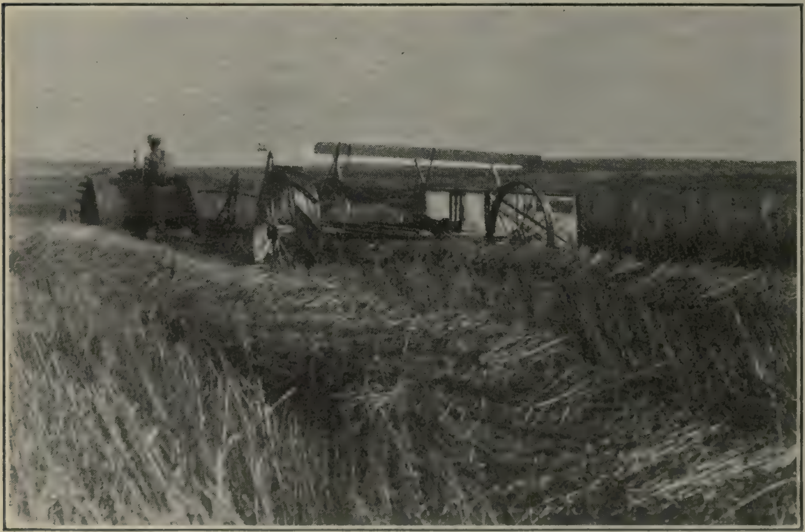

FIGURE 6.—Windrow harvester

WINDROW HARVESTER AND PICK-UP

Windrow-harvester and pick-up attachments may be secured for several makes of combines. With this auxiliary equipment the crop may be cut and piled in windrows, picked up when dry, and threshed with the combine. Fields badly infested with weeds and crops which do not ripen uniformly have been harvested successfully by this method. Under ordinary conditions the weeds and green grass dry out in four to eight days when windrowed, thus enabling the combine to do a better job of threshing and cleaning. A windrow harvester is shown in Figure 6, and a pick-up in Figure 7.

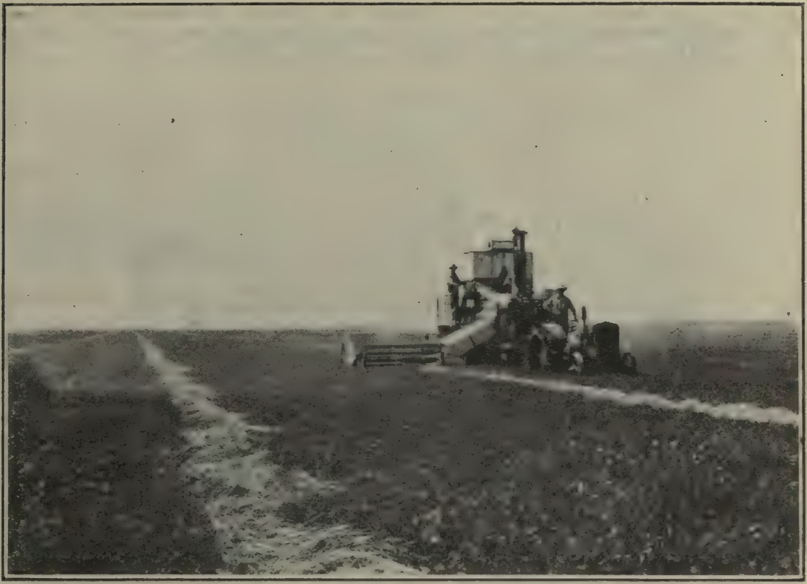

FIGURE 7.—Windrow harvester pick-up

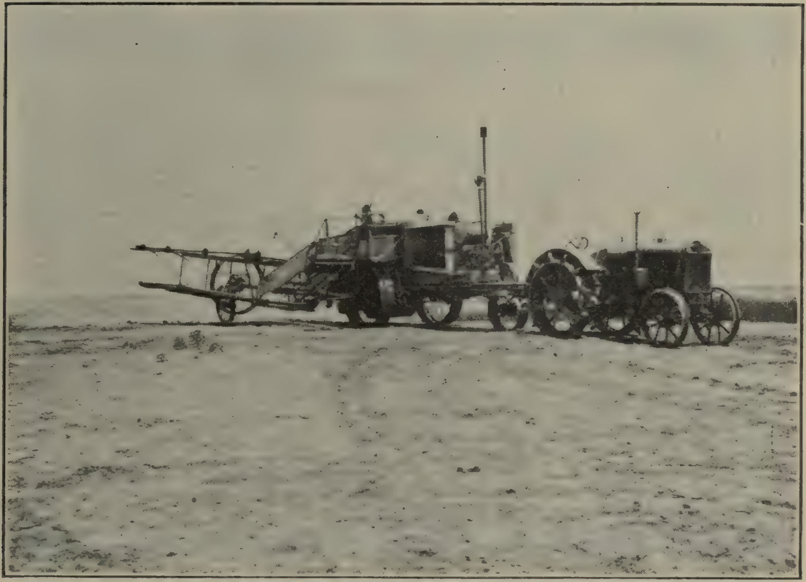

FIGURE 8.—Combine platform mounted on transport truck

TRANSPORT TRUCK

A transport truck is shown in Figure 8. The header platform is disconnected from the side of the machine, mounted on the transport truck, and pulled behind the combine. This reduces the over-all width by approximately the length of the header platform. On some of the smaller combines, as that shown in Figure 9, the platform may be folded up and back against the machine for transporting. When fences interfere with transporting the combine from field to field, it is usually advisable to let down the fence rather than truck the platform, as considerable time and effort are often required in attaching and detaching the platform.

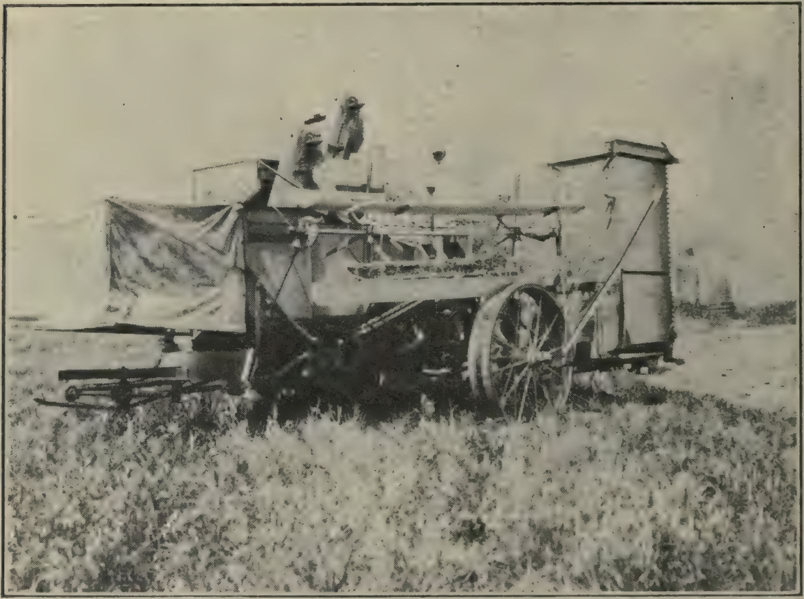

FIGURE 9.—Combine with platform raised for transporting

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Rec Oct '40

LETTUCE GROWING

By W. R. **Beattie**, *Senior Horticulturist, Office of Horticultural Crops and Diseases, Bureau of Plant Industry*

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ACREAGE AND PRODUCTION OF LETTUCE

THE ACREAGE PLANTED to the commercial lettuce crop of the United States in 1928, according to statistics recorded in the 1928 Yearbook of the United States Department of Agriculture, was 126,780 acres. The product of this area was 18,589,000 crates of four dozen heads each, valued at $31,601,300. This, however, does not include small lots of lettuce grown and marketed locally. Lettuce is grown on a large scale in no less than 15 States, but the bulk of the carload shipments originates in 10 States. The reported carlot movement of lettuce during 1928 was approximately 51,000 cars.

Table 1 shows the yearly carload movement of lettuce from 1920 to 1928. Carload shipments of lettuce increased more than threefold during this period. In 1928 California shipped more than 33,000 cars of lettuce, or more than half of the entire movement for the country. New York, Washington, Arizona, and Colorado were the other important producing States in 1928.

Table 1.—*Lettuce: Car-lot shipments by State of origin, 1920–1928* [1]

State	1920	1921	1922	1923	1924	1925	1926	1927	1928 [2]
	Cars	*Cars*	*Cars*	*Cars*	*Cars*	*Cars*	*Cars*	*Cars*	*Cars*
New York	1, 775	3, 240	3, 167	3, 817	3, 698	3, 821	3, 019	3, 496	3, 138
New Jersey	208	469	571	456	417	463	303	308	144
North Carolina	207	445	622	718	714	537	540	447	477
South Carolina	121	716	987	577	423	736	372	369	241
Florida	2, 940	2, 267	3. 323	3, 146	2, 257	1, 519	987	929	813
Idaho	25	180	889	1, 241	532	501	398	196	67
Colorado	129	234	812	1, 436	1, 036	3, 096	2, 795	2, 848	2, 368
Arizona	254	168	678	1, 108	2, 049	3, 519	4, 906	9, 131	9, 204
Washington	354	635	812	1, 081	674	820	904	1, 151	1, 232
California	7, 358	9, 850	9, 744	15, 113	18, 480	21, 618	27, 341	27, 574	33, 446
Other States	417	534	635	792	655	676	540	401	316
Total	13, 788	18, 738	22, 240	29, 485	30, 935	37, 306	42, 105	46, 850	51, 446

[1] United States Department of Agriculture, Statistical Committee. Agricultural statistics. U. S. Dept. Agr. Yearbook 1928: 801. 1929.

[2] Preliminary.

Table 2 shows the acreage, yield, and price per crate, by States, for the years 1925 to 1928, inclusive. Although there exists considerable price variation in the figures given, the general average for the 4 years was fairly uniform. The figures in Table 1 show that during the past few years there has been an enormous increase in the carload movement of lettuce, a part of which may be due to the extension of the industry to new territory, but more especially is it due to increased demand for this type of food.

TABLE 2.—*Lettuce, commercial crop: Acreage, production, and price per crate, by States, 1925–1928* [1]

Season and State	Acreage				Production				Price per crate [2]			
	1925	1926	1927	1928	1925	1926	1927	1928	1925	1926	1927	1928
	Acres	*Acres*	*Acres*	*Acres*	*1,000 crates*[3]	*1,000 crates*[3]	*1,000 crates*[3]	*1,000 crates*[3]	*Dolls.*	*Dolls.*	*Dolls.*	*Dolls.*
Early:												
Arizona [4]	6, 400	8, 500	14, 800	28, 700	1, 440	1, 912	3, 034	3, 272	1. 06	1. 90	1. 35	1. 42
California—												
Imperial [4]	23, 000	28, 000	34, 400	22, 000	4, 600	4, 900	5, 229	3, 740	1. 71	1. 95	1. 34	1. 62
Other	24, 680	37, 100	42, 010	50, 570	4, 368	5, 565	6, 049	7, 636	1. 16	1. 37	1. 75	1. 84
Florida [4]	3, 400	1, 500	1, 840	1, 850	765	252	294	314	1. 41	2. 21	1. 62	1. 61
North Carolina	1, 730	1, 420	1, 490	1, 490	467	379	207	216	1. 98	2. 00	1. 87	1. 60
South Carolina	1, 480	780	700	750	247	133	158	112	1. 69	1. 81	1. 59	2. 11
Texas [4]	680	640	950	1, 000	68	72	103	100	1. 38	1. 19	1. 00	1. 02
Virginia	300	300	300	300	39	38	50	60	2. 07	1. 70	1. 50	1. 45
Total	61, 670	78, 240	96, 490	106, 660	11, 994	13, 251	15, 124	15, 450	1. 42	1. 70	1. 37	1. 68
Late:												
Colorado	10, 500	13, 240	13, 240	9, 800	1, 396	1, 523	1, 456	1, 127	1. 58	1. 43	1. 63	1. 07
Idaho	1, 500	1, 200	1, 120	900	180	157	218	101	1. 86	1. 47	. 96	1. 67
New Jersey	2, 200	2, 400	2, 450	2, 300	541	503	612	442	1. 64	1. 08	2. 04	1. 89
New Mexico	1, 400	1, 030	410	400	280	77	59	18	1. 76	1. 66	. 75	1. 32
New York	6, 820	7, 200	5, 540	4, 460	1, 323	1, 246	1, 457	1, 004	1. 42	1. 60	1. 48	2. 68
Oregon	300	360	300	100	45	18	15	7	1. 92	1. 42	1. 25	1. 25
Pennsylvania	70	80	80	80	11	12	10	9	2. 50	1. 24	1. 50	2. 70
Washington	1, 450	1, 600	2, 050	2, 040	290	336	410	428	2. 50	1. 30	1. 48	1. 25
Wyoming	110	210	200	40	16	27	22	3	1. 50	1. 40	1. 20	1. 82
Total	24, 350	27, 320	25, 390	20, 120	4, 082	3, 899	4, 259	3, 139	1. 63	1. 43	1. 57	1. 75
Grand total	86, 020	105, 560	121, 880	126, 780	16, 076	17, 150	19, 383	18, 589	1. 48	1. 64	1. 42	1. 70

Of the 126,780 acres reported for the commercial lettuce crop during 1928, only about 12,000 were in the eastern United States. As already suggested, this does not include the many small areas in which lettuce is grown and marketed locally, and the total lettuce production in the eastern United States is of much greater importance than the figures would indicate.

On the basis of the farm value of lettuce for 1928, as computed by the United States Department of Agriculture, this crop ranked third among all vegetables, being exceeded by potatoes and sweet potatoes. Table 1 shows an annual increase of nearly 5,000 cars of lettuce shipped to the markets during the period from 1920 to 1928.

Lettuce is one of the most intensive of the vegetable crops in the United States, yielding a large return per acre, but involving high production costs. Lettuce production for the market is divided into three classes: Western outdoor lettuce, eastern outdoor lettuce, and that grown in greenhouses and coldframes. This bulletin deals mainly with the outdoor production of lettuce in the eastern United States, with brief reference to the methods employed in the western area.[1]

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[1] UNITED STATES DEPARTMENT OF AGRICULTURE, STATISTICAL COMMITTEE. AGRICULTURAL STATISTICS. U. S. Dept. Agr. Yearbook 1927: 876. 1928.

[2] Average for season.

[3] Crates of 4 dozen heads each.

[4] Harvest of crops begins in fall previous year.

It should be noted that during recent years there has been a great increase in the demand for the hard-heading western lettuce, mainly of the New York and Iceberg varieties. The increase in popularity of the solid-head lettuce has been due to its tender crisp nature when well grown and the comparative ease with which it can be delivered in good condition to distant markets. The green, loose-headed, and leaf varieties of lettuce have a higher vitamin content; but the hard-headed varieties, owing to their habit of close growth, are more hardy and less subject to injury in handling.

FACTORS GOVERNING THE FIELD PRODUCTION OF LETTUCE

Temperature, moisture, and soil are important contributing factors in the successful production of outdoor lettuce. Temperature is probably most frequently the limiting factor, since it is practically beyond control, while soil and moisture can often be modified to suit the crop. Lettuce requires a relatively low average temperature with freedom from periods of excessive heat, especially after the heads begin to form. Any good trucking soil will grow lettuce, provided moisture and plant-food conditions are suitable. Soil requirements consist of (1) adaptability to intensive cultivation, (2) capacity to retain moisture, and (3) an abundance of plant food. Good drainage is essential, and where the natural rainfall is insufficient or not well distributed some form of irrigation is desirable as crop insurance.

The greater part of the outdoor lettuce grown in the States bordering on the Great Lakes is produced on the peat soils, while that grown in the New England States and the southeastern part of the United States is grown mainly on lighter sandy loams. The great lettuce fields of the western coast are located mainly on alluvial and semialluvial soils of a texture varying from sandy loams to heavy clay silt loams.

Climatic conditions suitable for growing lettuce during the winter months are found in the southern part of Florida, in the Imperial Valley of California, and in parts of Arizona and Texas. The climate of the central section of California and of the greater part of the Atlantic Coast is adapted to the growing of early-spring and late-fall lettuce, whereas the best summer lettuce is grown at high altitudes in Colorado and Idaho and in the Great Lakes region. In these several localities and at different seasons of the year suitable climatic conditions prevail for the production of head lettuce, so that a practically continuous supply is available.

In the western lettuce-growing section the crop is produced almost entirely under irrigation. In the eastern part of the United States natural rainfall is frequently supplemented either by subirrigation or by an overhead sprinkler system. Much of the eastern lettuce acreage, however, is dependent entirely upon natural rainfall, especially on the peat lands of the Great Lakes region.

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[1] The production of lettuce in greenhouses is discussed in the following publication: BEATTIE, J. H. LETTUCE GROWING IN GREENHOUSES. U. S. Dept. Agr. Farmers' Bul. 1418, 22 p., illus. 1924. The culture of lettuce in California, Arizona, and Colorado is discussed in bulletins issued by those States.

ROTATIONS

Crop rotation in lettuce growing has proved to be of value, both in the control of diseases and in the maintenance of soil fertility and physical conditions through the use of green manures. There are certain diseases, briefly considered in this bulletin, that cause serious losses to the lettuce crop, both in the field and in transit, and crop rotation is one of the means of preventing the development of these diseases. Cases are on record, however, where five to eight successive spring and fall crops of lettuce have been grown on the same piece of land without serious losses from diseases.

Although it would be impossible to outline definite rotations, because of the various conditions under which lettuce is grown, it should be the practice of the grower to plant lettuce on a given piece of land not oftener than once or twice in three or four years. Some growers follow the practice of planting a fall and a spring crop of lettuce on the same piece of ground, then utilizing this particular piece of ground for other crops for at least two years. Soil-building crops, such as cowpeas, soybeans, velvetbeans, rye, vetch, and sorghum, may be employed to advantage for maintaining the humus content of the soil. Field corn should not be grown in rotation with lettuce, as it draws too heavily upon the plant-food supply of the soil. In the Western States land on which alfalfa has been turned under is considered excellent for lettuce.

MANURES AND FERTILIZERS

Lettuce requires a large supply of plant food in the soil, and the most successful lettuce growers, especially those of the eastern United States, use stable manure in large quantities whenever it can be obtained at a reasonable price. Manure containing a large proportion of undecayed straw or other coarse bedding should not be applied, because the decay of coarse straw or other woody materials results in the temporary depletion of the available nitrogen in the soil. This is likewise true of soil-improving crops used as substitutes for manure, and these should be turned under while green and in condition to decay quickly. Thorough disking of the material in advance of plowing will greatly facilitate the disintegration of the organic matter. Some of the most successful lettuce growers of the Atlantic coast region follow the practice of disking their soil before plowing and redisking it eight to twelve times after plowing.

The manure for use on lettuce land should be composted in a compact pile for at least three months and preferably six months in advance of being spread on the land. During this period the leachings from the pile should be collected in a pit and pumped over the pile of manure from time to time. If the manure is excessively dry at the time it is piled for composting, enough water should be added to cause it to decay rapidly. The manure is usually spread broadcast over the land with a spreader or by hand at the rate of 20 to 40 tons to the acre and thoroughly disked into the soil. One such application every three years interspersed with at least two soil-building crops will usually be sufficient to maintain the organic matter in the soil.

Commercial fertilizers analyzing from 5 to 7 per cent nitrogen, 8 to 10 per cent phosphoric acid, and 5 to 6 per cent potash are used at the rate of 1 ton or more per acre for growing lettuce. Top-dressings of nitrate of soda at the rate of not more than 300 pounds to the acre, or other readily available sources of nitrogen in corresponding quantities, are frequently applied to the growing crop. The total quantity of fertilizer applied to a crop of lettuce will depend upon the fertility and character of the soil, but in view of the intensive character of the crop it requires high fertilization.

The time of applying fertilizers varies with the locality, but as a general rule the main application of commercial fertilizer is made just prior to planting and during soil preparation. The southern New Jersey lettuce growers follow the practice of applying 1 ton of bone meal to the acre during August or just before planting the fall crop. This gives a slowly available but constant source of plant food, especially of phosphorus. As a general rule, all fertilizers are spread broadcast and thoroughly disked into the soil. Top-dressings of nitrogenous fertilizers are not recommended after the heads begin to form, on account of the tendency to make the heads loose and of poor shipping quality.

LIME

Recent experiments conducted to determine the response of lettuce to applications of lime indicate that on many soils sufficiently supplied with plant food there is little or no response to lime; in fact, some of these experiments show harmful results when lime is applied. The Rhode Island Agricultural Experiment Station found that lettuce is benefited by applications of lime to the particular type of soil on which their experiments were conducted.

At the Virginia Truck Experiment Station near Norfolk, Va., T. C. Johnson and his associates found that the growth of both Big Boston and New York varieties of lettuce was improved by moderate applications of lime. These experiments were conducted on what is known as a Sassafras loam soil. Where the soil was extremely low in lime content and showed a decided acid reaction the lettuce made little or no growth, but where just enough lime was applied to bring the soil to a point slightly below neutral the lettuce made good growth. It was found, however, that where the reaction showed the soil to be neutral or alkaline there was a check in the development of the plants. The conclusions reached by those in charge of these experiments were "that high alkalinity does not seem to be conducive to good lettuce growth." Professor Crist, of the Michigan Agricultural College, in growing the Grand Rapids variety of lettuce in greenhouses found that the natural low lime content in the soils under investigation did not have much effect on the development of the crop, but that heavy applications of lime did have a depressing effect.

From these experiments it would appear that the lime requirement for lettuce is dependent almost wholly upon the local character and condition of the soil under treatment, and as a general principle lime should not be used unless shown to be necessary by a test of the soil in question. County agricultural agents are often prepared to make soil-acidity tests, or they can at least refer the matter to the workers in their State colleges and experiment stations for a determination. Present knowledge of the subject would further indicate that heavy applications of lime are undesirable in lettuce growing and that the margin of safety is rather narrow.

SOIL PREPARATION

The method of preparing the soil for planting to lettuce varies with the locality. The peat soils of the Great Lakes region are usually plowed and harrowed with a tractor. These lands as a rule are divided by drainage ditches into beds about 75 or 100 feet in width and from 60 to 90 rods in length, adapting them to tractor preparation. The number of diskings and draggings necessary to get the peat soils in condition for planting will depend upon the length of time that the land has been under cultivation and the general character of the soil. The preparation, however, is usually completed by means of a plank drag or with a Meeker harrow (fig. 1), which leaves the soil with a smooth surface.

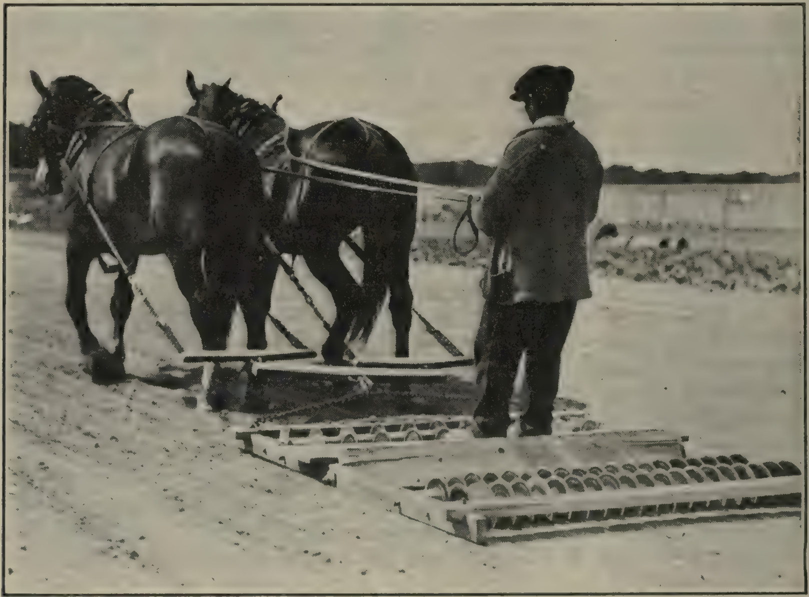

FIGURE 1.—Meeker harrow used for finishing the preparation of the soil before planting lettuce

On the sandy soils of the Atlantic coast the plowing is done either with tractors or with teams, in many sections the land being bedded on 4-foot centers by means of 1-horse turning plows. In all cases the soil is harrowed and dragged until it is thoroughly pulverized before planting.

Lettuce grown in the irrigated regions of the West is planted on raised beds, the general custom being to grow two rows on a bed with irrigation furrows between the beds. In some sections of the West lettuce is planted in single rows on raised beds. It is essential that the beds should be of a uniform height, in order to avoid flooding certain areas while others remain dry. For this reason the land should be carefully leveled following plowing in order to fill all depressions. This is usually done by means of a float consisting of planks set on edge but slightly inclined backward. In general, the soil should be plowed, disked, and harrowed to a fine mellow condition before the beds are made. When alfalfa land is broken preparatory to planting lettuce, it is given a deep plowing several months in advance and allowed to remain in a rough condition until about a month before planting. A second plowing is then given, followed by a light irrigation. As soon as the ground is dry it is disked and then leveled with a float, after which the beds are made.[2]

VARIETIES

The commercially important varieties of head lettuce being grown in the United States at present are New York, Iceberg, May King, Salamander, Hanson, and Big Boston and its variations. The greater part of the carload movement consists of three varieties—New York, Iceberg, and Big Boston. Grand Rapids and Early Curled Simpson are the two important varieties of loose-leaf lettuce grown for the Market in the United States; these two varieties, however, are of relatively little importance in the general car-lot distribution, except as grown in greenhouses.

New York.—(Also known under the names of Los Angeles, Imperial, and Wonderful.) This variety was first listed in this country about 30 years ago by Henderson. It is one of the most popular varieties, especially for planting in the western part of the United States. It is a curled and crisp-heading variety; heads large, dark green, and slightly curled on the edges. The head at first is pointed or conical, but becomes globular at maturity; outer leaves dark green in color, center leaves a pale green, overlapping and folding, making a compact head; outer leaves frequently spread to a diameter of 12 or 15 inches, center or solid part of head frequently 7 inches in diameter, the usual size being about 5 inches. The head has a crumpled appearance and is white inside. It is easily distinguished from Iceberg by its deeper green color of leaves and its freedom from reddish brown tinge on margin of the inner leaves. (Fig. 2.)

Iceberg.—Curled or crisp heading, medium large, medium green; leaves wavy with fringed edges; inner leaves tinged at margins with reddish brown; forms a large, compact, crumpled head, very white inside. When grown on good soil the heads, including the outer leaves, frequently measure 15 inches in diameter, the center or solid part being somewhat angular and 5 to 7 inches in diameter. It is lighter in color and has a slightly flatter head than New York. Under normal conditions it matures three to six days earlier than New York. This is the Iceberg variety type (fig. 3), although most of the lettuce appearing on eastern markets under the name "Iceberg" is of the variety known as New York, Los Angeles, Wonderful, or Imperial.

Big Boston.—Probably the most widely distributed variety in cultivation, Big Boston (fig. 4), is listed by practically every seed house in America and Europe. Heads are medium large, usually referred to as butter type; medium light green, with slight tinge of reddish brown on the margins of the inner leaves; leaves smooth and not blistered or savoyed. The head itself is tender and buttery, and the interior is of a light golden yellow; has a decided tendency to tipburn and does not withstand hot weather. This variety and its numerous strains have been planted almost exclusively for the carload production of the eastern United States. During recent years, however, several successful attempts have been made to grow New York and Iceberg in various parts of the East.

There is a strain of the Big Boston type which has light-green foliage, free from the reddish-brown tinting on the edges of the inner leaves, and which does

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[2] From the following publication: JONES, H. A., and GARTHWAITE, E. L. THE GROWING AND HANDLING OF HEAD LETTUCE IN CALIFORNIA. Calif. Agr. Expt. Sta. Circ. 295, 36 p., illus. 1925.

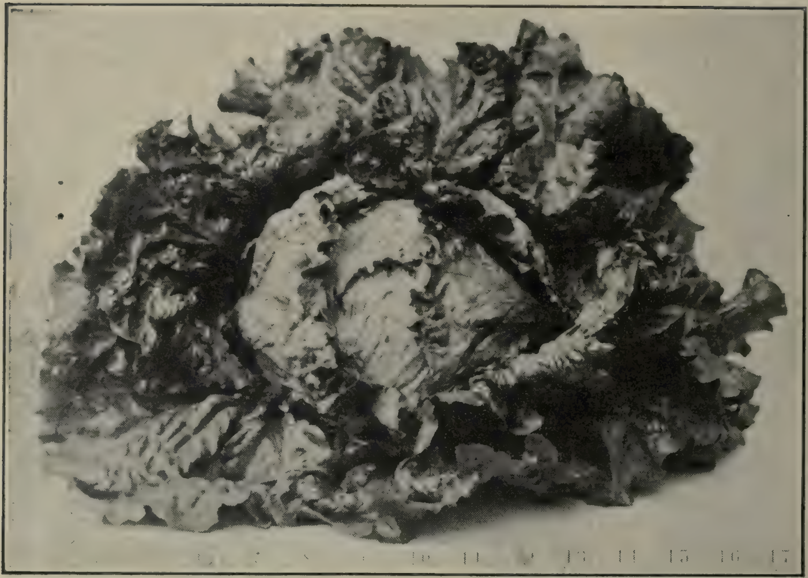

FIGURE 2.—Head of the New York variety of lettuce, also known as Los Angeles and Wonderful. This variety is sold under the trade name "Iceberg"

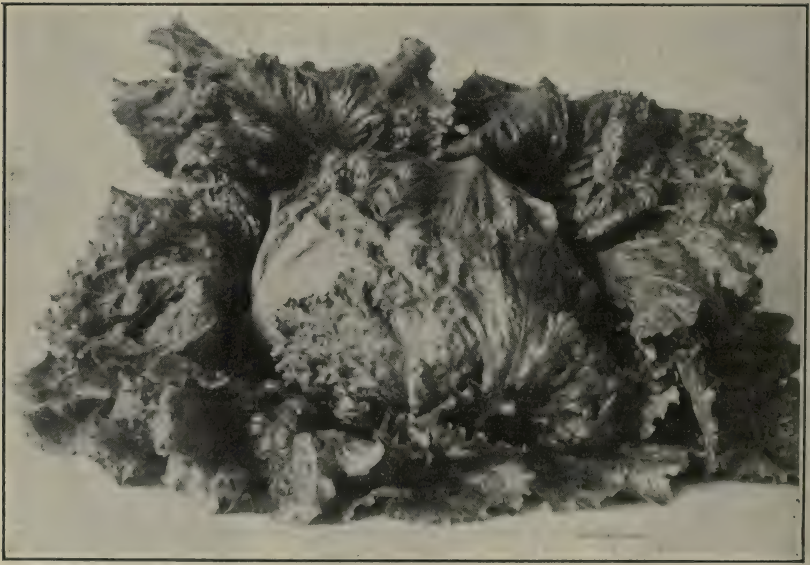

FIGURE 3.—Head of true Iceberg lettuce

not tipburn as does the regular Big Boston. Seed of this strain is sold under the names of White Big Boston, Unrivaled, and various local names. It is especially suitable for growing as a spring crop for the market and for home use.

May King.—One of the favorite varieties of head lettuce, especially in the northeastern part of the United States, is the May King (fig. 5), known as a butterhead type. It is an early variety and especially adapted for coldframe and outdoor culture in the spring. Heads are medium size to small, upright, and slightly pointed at first, but rounding out and forming a compact head at maturity; color of leaves light green, slightly tinged at edges with brown. It is grown extensively as a coldframe lettuce in the eastern United States.

Hanson.—Introduced many years ago, Hanson (fig. 6) is one of the best known of the old standard varieties. Heads medium to large; leaves curly, edges fringed and outer ones dark green. When well grown it forms a solid, white, crisp head, similar in many respects to New York, but the heads are usually smaller; matures rather early and shoots to seed quickly after maturity, especially under warm-weather conditions. Because of its fine quality, it is a desirable variety for the home and market garden.

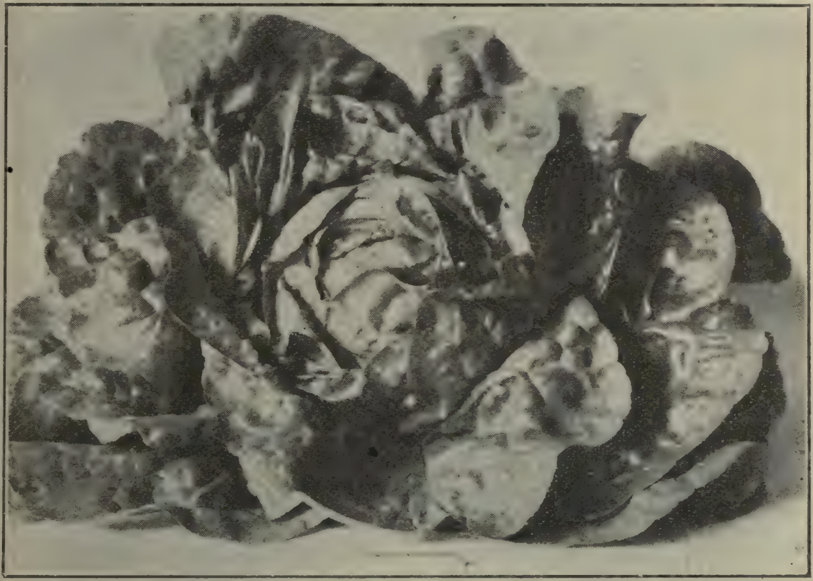

FIGURE 4.—Typical head of Big Boston lettuce

Salamander (Black Seed Tennisball).—One of the five most popular varieties of head lettuce, Salamander (fig. 7) is a cabbage butterhead, of medium size, solid head; medium green; leaves crumpled, but straight on edges. It is excellent for early spring growing, matures about three days later than May King, shoots to seed quickly, and must be handled very promptly after heads are fully formed. The plants occasionally have the peculiar characteristics of throwing out numerous side shoots before heads are fully formed.

Romaine or Cos.—Romaine lettuce (fig. 8) is grown extensively for local marketing and to some extent for shipping. It is, however, of a type distinctly different from the ordinary head lettuce. Heads are large, upright, elongated, compact, but not hard; leaves long, narrow, dark green; inner leaves yellowish, bleaching to creamy whiteness; leaves folding at top of head; tipburns to some extent during warm weather; quality excellent, crisp, and tender; flavor rich, but delicate and pleasing; especially adapted for serving with vinegar dressing.

Grand Rapids.—Originated many years ago by Eugene Davis, of Grand Rapids, Mich., the Grand Rapids variety (fig. 9) is probably the best known and most popular of the loose-leaved nonheading sorts. It has been used very extensively as a greenhouse lettuce throughout the northeastern United States.

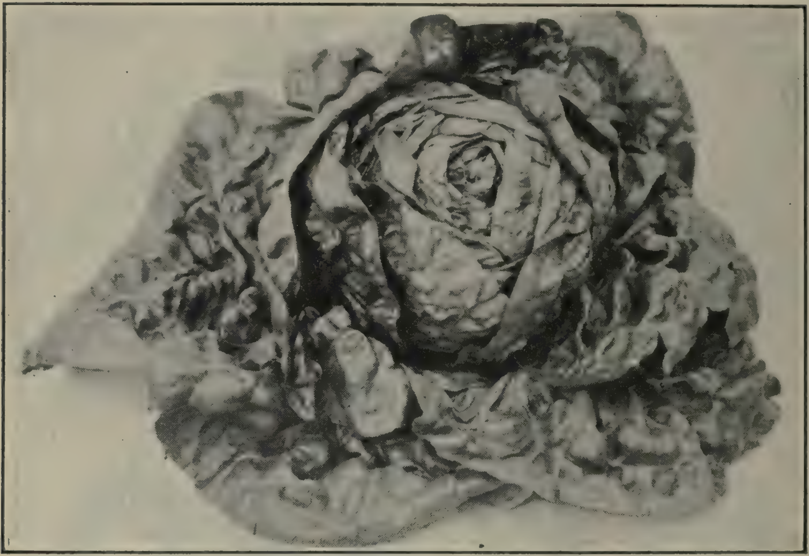

FIGURE 5.—Head of May King lettuce

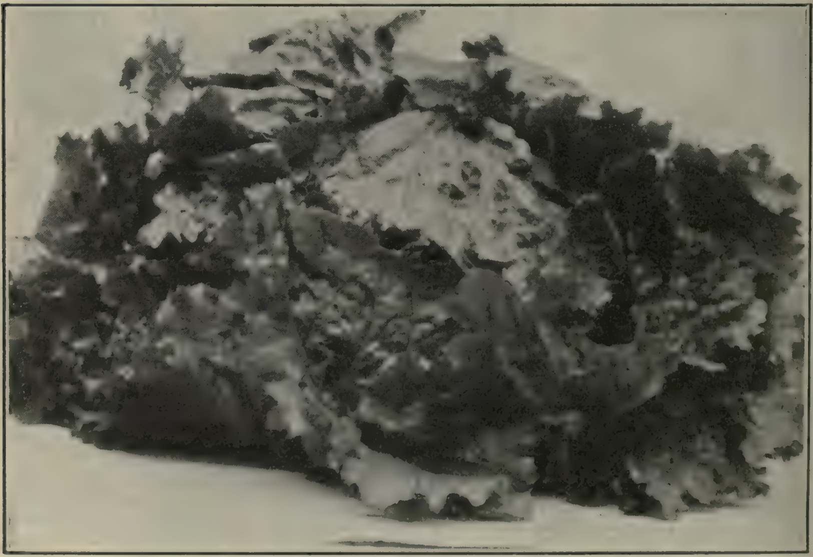

FIGURE 6.—Head of Hansen lettuce

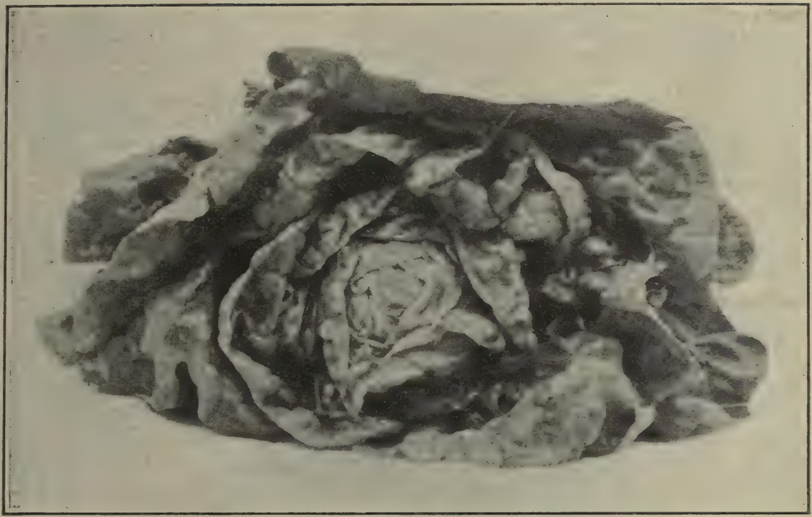

FIGURE 7.—Head of salamander lettuce

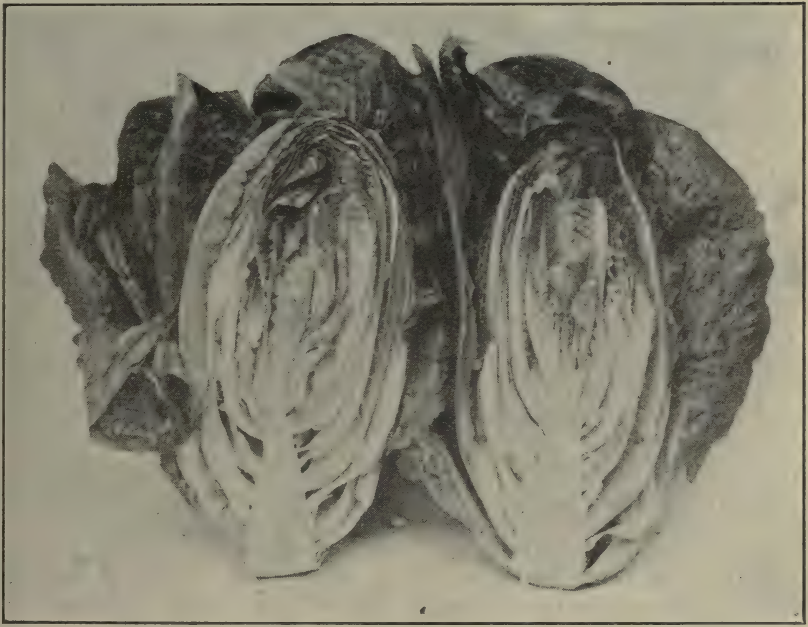

FIGURE 8.—Cross section of head of Romaine or Cos lettuce

It is grown in home gardens and in market gardens for local trade and withstands heat better than most of the heading sorts. The leaves are rather deep green in color and curled. If planted closely—that is, about 6 by 8 inches—on good soil, it will produce well-bleached, tender inner leaves, especially desirable for garnishing. It is well adapted to growing in coldframes as an early spring lettuce.

Early Curled Simpson.—A nonheading, bunching, crisp variety, light yellowish green and of large size. The texture of the leaves is fine and delicate, and the variety is used extensively by market gardeners for hotbed culture. It is one of the most popular American varieties of loose-leaf lettuce and withstands the heat of early summer better than the heading varieties.

SEED SUPPLY

Most of the lettuce seed used in the United States is grown in California. A few growers throughout the country follow the practice of selecting special plants and growing their own seed, but as a rule greater uniformity and closer selection of type is obtained where the seed is grown in considerable quantities by commercial growers.

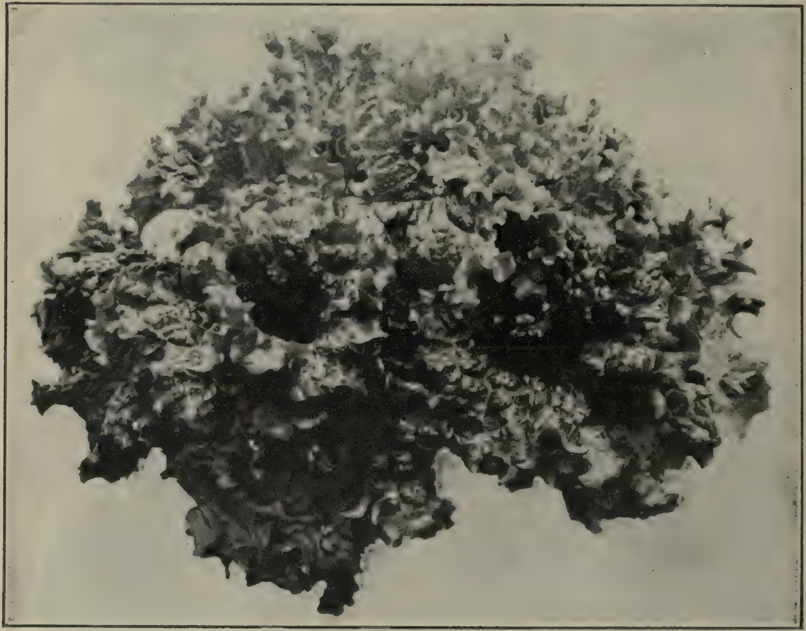

FIGURE 9.—Grand Rapids loose-leaf lettuce

Where the lettuce seed is sown in beds and the seedlings transferred to the field, one-half pound of seed will produce enough plants to plant an acre. Most lettuce growers use 2 pounds of seed to the acre when seeding directly in the field, but with good seed and careful sowing the quantity of seed may be reduced to 1 pound and will result in a corresponding reduction in the thinning of the plants. A good grade of lettuce seed of any of the standard market varieties can generally be sold at prices from $1 to $1.50 a pound. In a few cases prices as high as $3 or $4 a pound are being charged for choice selections.

Letture seed retains its viability for several years if stored under proper conditions, but in order to obtain vigorous plants it is recommended that seed not more than 2 years old be planted. Strictly fresh lettuce seed, that is, seed that is planted the same season that it is grown, is likely to give a poor germination, and for that reason it is desirable to plant seed grown the previous season.

PLANTING

A large proportion of the commercial crop of head lettuce is started in beds and transplanted to the fields. The usual custom is to prepare seed beds either in hotbeds, in coldframes, or in the open ground, fertilize the soil of the seed bed somewhat highly, about 4 pounds of fertilizer per 100 square feet, and sow the seed thinly so as to produce strong, healthy plants. As heretofore stated, one-half pound of good seed planted in a special seed bed will produce enough plants with which to set an acre of lettuce. Approximately 50 coldframe sash 3 by 6 feet will be required for growing these plants. Where the beds are in the open and not covered with sash, a bed 100 feet long and 12 feet wide is recommended. While standard 3 by 6 foot hotbed or coldframe sash are frequently used for covering the beds, very good results can be obtained by making the beds 12 or 14 feet in width and covering them with muslin or tobacco cloth supported upon crosspieces of lath. Great care must be taken in the watering and ventilation of the plant beds in order to avoid severe losses by damping off. This disease seldom gives trouble in the open beds, except during seasons of excessive rainfall accompanied by warm weather.

Lettuce growers sometimes start the plants by drilling the seed in rows in the open ground, using an ordinary garden seed drill and spacing the rows 10 or 12 inches apart. Where the seed is sown in this manner the plants will be ready for setting in the field in from 30 to 40 days.

Successful head-lettuce production, especially in the eastern part of the United States, is dependent upon bringing the heads to maturity at a time when temperature conditions are favorable. The spring crop, where seeded in the open ground, is almost certain to run into the hot weather of early summer and fail to produce solid heads, shooting to seed before becoming marketable. To overcome this difficulty certain growers have adopted the practice of sowing the seed in greenhouses, in mild hotbeds, or in well-protected coldframes. By this method the plants are of considerable size when conditions will permit of their being set in the open ground. By planting as early as possible on well-prepared rich soil, the crop can be brought to maturity late in May or early in June, in advance of hot weather. Crops of New York, Iceberg, May King, and Big Boston, yielding upwards of 1,000 crates to the acre, are now occasionally being grown in this manner by eastern growers.

Lettuce grown on the muck areas of the Great Lakes region is practically all seeded in place and the plants thinned to a uniform stand. In the case of the late or fall crop in the eastern United States, the seed is planted in the field with a seed drill, and when the plants are well established they are thinned first by chopping out with a hoe and later by hand thinning to provide a uniform stand.

Planting distances vary with locality, depending upon the system of cultivation or irrigation. In the western sections where the crop is grown almost entirely by furrow irrigation, the usual custom is to plant on the 2-row bed, the beds being approximately 20 inches in width with a space of 14 inches between the rows on the beds. The irrigation furrow between the beds is usually 22 inches, making a total of 42 inches for the combined furrow and bed. The width of the bed, the distance between the beds, and the depth of the furrow vary according to the locality and the type of soil.

In Florida the greater part of the lettuce crop is grown by level culture on slightly raised beds, the distance between the rows on the beds being from 12 to 15 inches, so as to accommodate the wheel hoes used for cultivation. In the Wilmington (N. C.) district, head lettuce is grown both by single-row culture and by the bed method. When planted in single rows for horse cultivation, the rows are spaced 21 inches apart and the plants 9 inches apart in the rows, as shown in Figure 10. By the 2-row bed method, the beds are spaced 4 feet apart, center to center, two rows of lettuce 15 to 18 inches apart being planted on top of each bed, as shown in Figure 11. Later in the season when the crop is nearly grown a row of cucumbers is planted in the center of the bed halfway between the rows of lettuce.

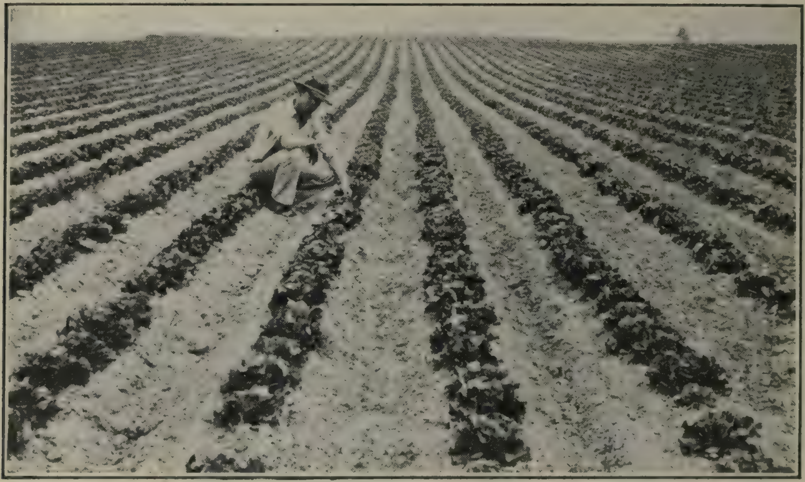

FIGURE 10.—Single-row planting system for horse cultivation

In the Norfolk-Portsmouth (Va.) district, lettuce is planted for the most part on 6-foot or 7-foot beds, six rows being planted on each bed, as shown in Figure 12. In southern New Jersey the plants are set in checkrows 12 to 15 inches apart in each direction so as to permit of cultivation both ways. (Fig. 13.) In northern New Jersey the plants are frequently set in double rows, the two rows being about 1 foot apart with a space of about 18 inches between the double rows. On the peat lands of the Great Lakes region (fig. 14) the rows are spaced 12 to 18 inches apart according to the type of cultivation employed. The plants of the smaller heading varieties are set 8 to 10 inches apart in the rows, whereas those of the large heading varieties,

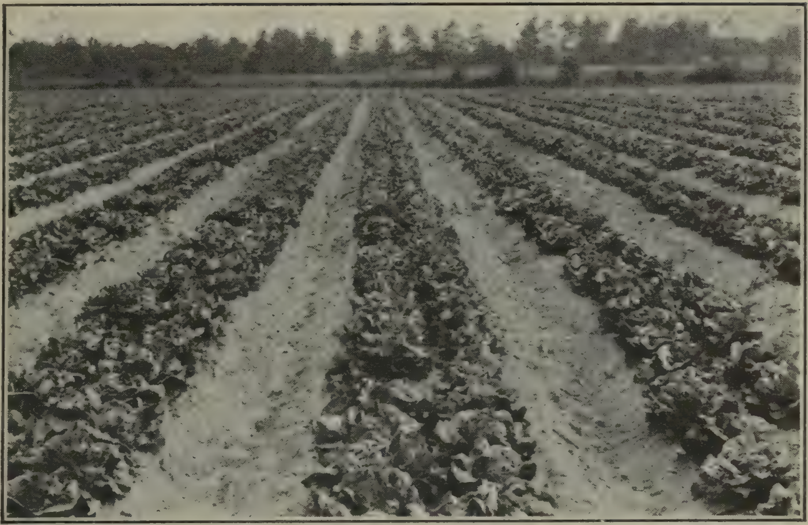

FIGURE 11.—Double-row planting system on slight beds

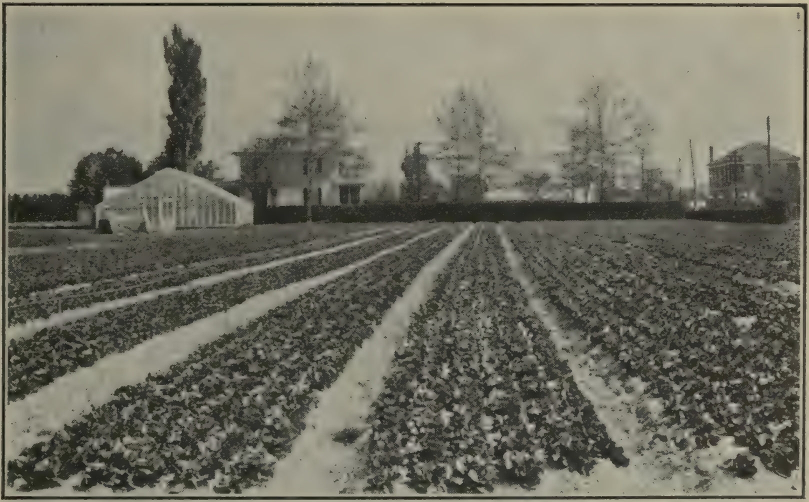

FIGURE 12.—Lettuce planted on 6-foot beds

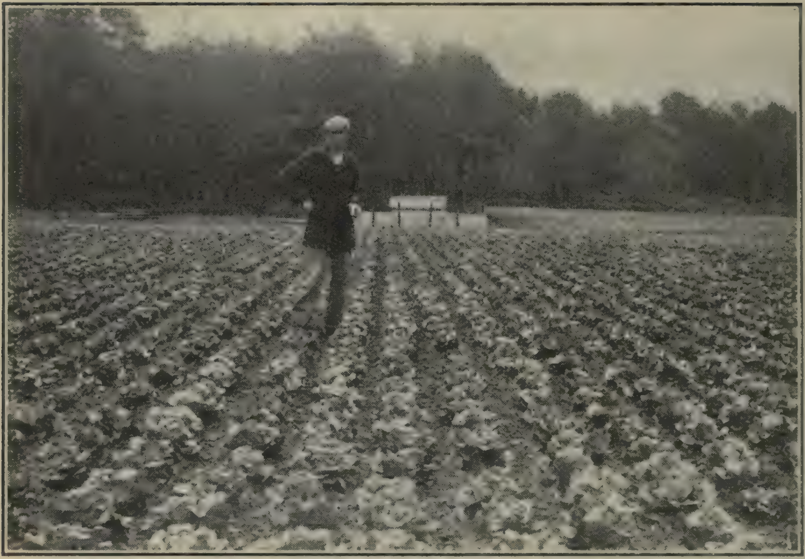

FIGURE 13.—Lettuce planted in checkrows

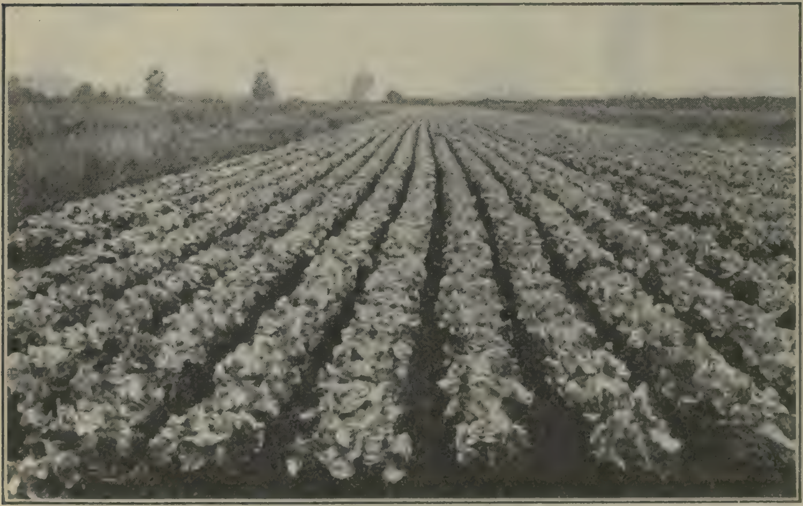

FIGURE 14.—Lettuce on peat lands of the Great Lakes region

such as New York and Iceberg, must be given at least 12 and preferably 15 inches in the row.

The work of setting the plants in the field is usually done by contract at so much a bed or an acre. The plants are lifted from the seed bed in baskets or trays and are hauled to the field, where they are dropped by boys or girls ahead of the planters. The planters follow closely and set the plants with small trowels or dibbers. To set an acre of lettuce with the rows 18 inches apart and the plants 12 inches apart in the rows will require approximately 29,000 plants, and the work can be done by a man and a boy in about three days. The cost of setting an acre of lettuce plants in the eastern United States varies from $18 to $30.

Throughout the Eastern States the fall-grown lettuce crop is usually seeded directly in the field. The rows are spaced 15 to 18 inches apart, either on narrow beds or on the level, and after the plants are established they are thinned to the desired distance, usually 9 inches apart in the rows for the smaller heading varieties. Gang seeders are frequently employed, but any seed drill of a standard make can be used for planting lettuce. The use of gang seeders insures greater uniformity in the width of rows and simplifies cultivation. The seed is usually sown about the first of August in New Jersey, Delaware, and eastern Maryland; in fact, lettuce planted any time during August in that section will, as a rule, make a fall crop in the open. Under favorable conditions, the plants will be well established and ready for the first thinning about two weeks after seeding.

On heavy land, especially the clay soils of the West, difficulty is experienced with the crusting of the surface, which interferes with the coming up of the seedlings. Where this occurs, the seed beds are sometimes covered by sifting a thin mulch of fine manure over the surface, or a thin layer of sand is sifted over the beds after seeding. Where the seed is sown in the field the drill may be fitted with a hopper from which a small stream of mulching material is scattered directly on the row over the seed. Keeping the soil moistened by means of frequent light irrigations is the most common method of preventing its baking over the lettuce seed. Another method is to keep the soil both cool and moist during the germination period by allowing a small stream of water to flow continuously through the furrows.

THINNING

Thinning is the most laborious task connected with the culture of lettuce. Transplanted lettuce does not require thinning in the field, but some replacements are usually necessary, while lettuce that is seeded in place will require careful thinning. The first thinning is usually done in from 10 days to 2 weeks after the seed is sown, the plants being simply blocked out by chopping with a hoe or by means of one of the modern thinning machines. In either case this method leaves the plants in clusters 8 to 10 inches apart with open spaces between them. Within two or three days after chopping out the plants it will be necessary to thin the clusters by hand to a single plant. The plants removed in thinning are often used for setting additional areas or for replacements. Many growers use a spoon as an aid in thinning. A special spoon about the size of a teaspoon can be made from a piece of steel, a wooden handle being supplied, and if the edges are kept sharp this is very effective for cutting out the surplus plants. An ordinary teaspoon with the handle wrapped and the edges sharpened is fairly effective, or a hook made from a thin piece of steel can be effectively used. In the final analysis, however, a certain amount of thumb and finger thinning is necessary.

Where fall lettuce is being grown under irrigation in the Eastern States, it is probably more economical to grow the plants in a bed and transplant rather than to seed in place and thin. Without irrigation, however, it is very difficult to grow lettuce in the fall by transplanting, as the check incident to setting the plants under more or less dry conditions is too great.

CULTIVATION

Hand cultivation is used for the most part in the growing of lettuce, but in a few sections the rows are spaced so as to permit of horse cultivation. Small garden tractors are now being employed extensively, both for drawing the gangs of seed drills used in sowing the lettuce and for its cultivation. The object of cultivation in lettuce growing is primarily the control of weeds, as the soil is thoroughly prepared before planting. Where the plants have been transplanted in check rows they can be cultivated in both directions until the heads begin to form. This will eliminate a large part of the handwork of hoeing and weeding. Where lettuce is seeded in place and thinned, it is impossible to have the plants in checks, thus restricting the cultivation to one direction only. The effectiveness of wheel-hoe and garden-tractor cultivation depends not only upon the use of the proper attachment but also upon the skill of the operator. Figure 15 shows a typical hand wheel hoe with the attachments for the various stages of lettuce cultivation. Figure 16 shows a typical small garden tractor in use for cultivating lettuce.

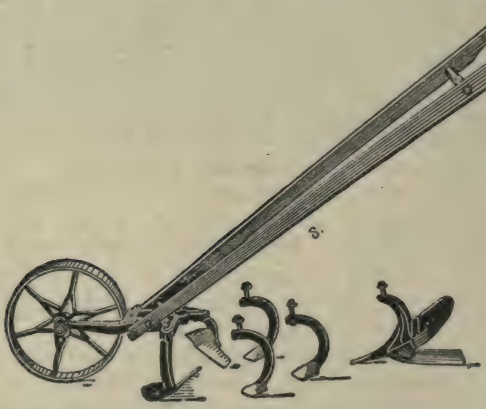

FIGURE 15.—Wheel hoe frequently used for cultivating lettuce

During the cultivation of the lettuce crop, highly nitrogenous fertilizers are frequently applied to stimulate growth. As a rule, about two applications of either nitrate of soda or some mixed fertilizer containing a high percentage of readily available nitrates are applied at the rate of 150 to 300 pounds per acre at each application. The first application is usually made at the time the lettuce is given its second cultivation, and the second application about two weeks later. The fertilizer is sometimes sown broadcast when the plants are free from rain or dew and is immediately cultivated into the soil. A much better method, however, and one that precludes any possibility of burning the foliage, is to use a combination hand cultivator and fertilizer distributor which can be run between the rows of plants, thus distributing the fertilizer and working it into the soil at one operation.

The number or frequency of cultivations required to grow a crop of lettuce varies with the character of the soil, the seasonal conditions, and the growth of weeds. No definite rule can be laid down, but generally four or five cultivations and one or two hoeings by hand should be sufficient to carry the crop through in good condition.

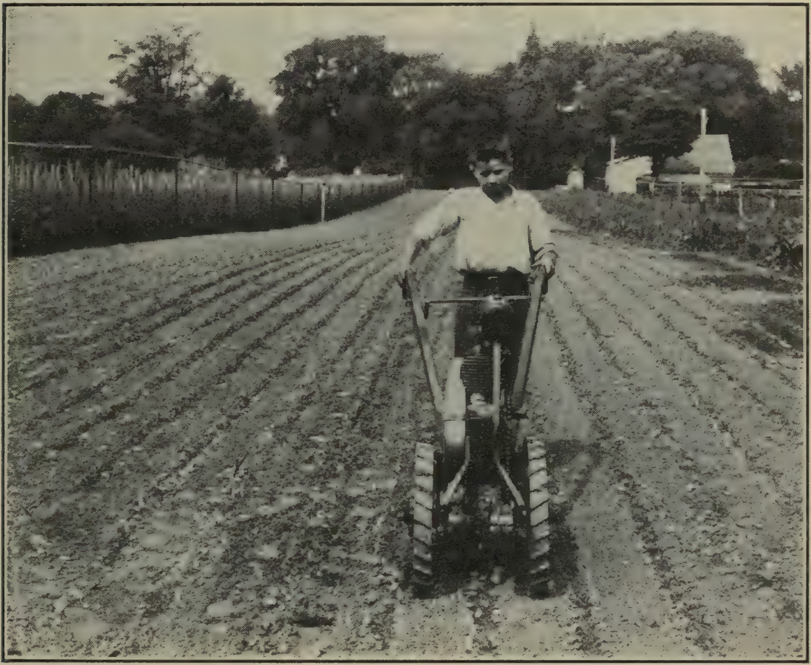

FIGURE 16.—Small garden tractor such as is used for cultivating lettuce

IRRIGATION

Lettuce requires a constant and fairly high moisture content in the soil, but excessive rainfall or irrigation will seriously damage the crop. On the other hand, lack of moisture in the soil will stunt the growth and produce poor heads. A moisture condition in the soil which is just a little greater than that required for good transplanting is satisfactory for the growing of lettuce. In other words, the moisture content of the soil should be just about as great as is permissible for cultivation. At no time except immediately following a rain or irrigation should the soil be so wet as to form balls when squeezed in the hand. Extreme care must be taken in handling overhead irrigation that the soil does not become puddled from overwatering, and in no case should the plants become flooded. Water should be applied sparingly as the harvesting period approaches, in order to improve the carrying quality of the product. In general, less water is required for the fall crop than for the spring crop.

In sections having natural rainfall, the irrigation of the lettuce crop should be carefully studied from the standpoint of weather forecasts with relation to the condition of the soil moisture. The most expert growers keep a careful watch on both the weather and their lettuce crop, applying only enough water to carry the plants through until it rains. During continued dry weather, irrigations usually are given about once a week, or as actually needed. Lettuce grown in the eastern or humid regions requires from 5 to 8 inches of rainfall or its equivalent in irrigation to produce a spring crop, the amount being somewhat dependent upon the character of the soil, the percentage of cloudy weather, and the prevalence of winds. The ordinary overhead or spray system will distribute approximately 60 gallons of water per minute over an acre, thus requiring about four hours' watering to apply one-half inch of water over the entire surface, or sufficient to fairly saturate the soil. Figure 17 shows a field of lettuce grown under spray irrigation.

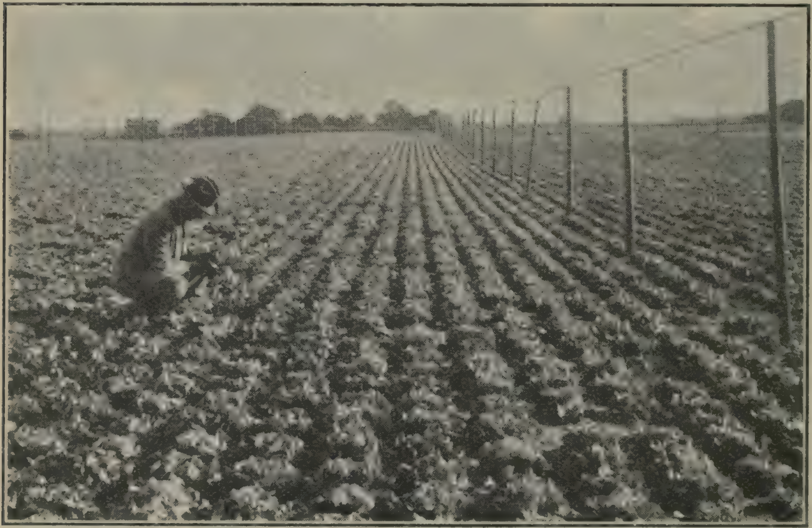

FIGURE 17.—Lettuce grown under overhead irrigation

In the western lettuce-growing sections irrigation practices vary with the locality and the character of the soil. In heavy clay soils deep furrows are used with a small head or flow of water. If the water comes close to the top of the bed the soil will bake and crack when it dries, and the seedlings will not come through. It is best to irrigate sparingly when the plants are small, also when the crop is maturing. More frequent irrigations are needed on light sandy soils than on the clay loam soils. Less water is needed when the air is cool and moist than when drying winds prevail. These and many other points regarding the growing of western head lettuce are covered in the bulletins issued by the States in which the crop is extensively grown.

INSECT ENEMIES OF THE LETTUCE CROP[3]

CUTWORMS

Fortunately, the lettuce plant is comparatively free from insect attack. There are a few pests, however, that cause considerable trouble to the lettuce grower. Cutworms are particularly destructive to the seedling crop. There are many kinds of cutworms. Some forms winter over in the soil in the immature worm stage, and as soon as the weather becomes favorable in the spring they are ready to attack the early-planted crop. Later in the season the crop may be damaged by cutworms that pass the winter in the egg stage. The crop is also subject to attack from worms that hatch from eggs laid by the moth in early spring and through the season. Cutworms damage the crop by cutting the plants off near the ground. They feed for the most part at night, spending the day inactive just below the surface of the soil.

Cutworms may be readily controlled by the timely use of a poisoned-bran bait, as shown in Table 3 and in the directions that follow.

TABLE 3.—*Poisoned bran bait for control of cutworms*

Ingredient	In small quantities	In large quantities
Dry bran	1 peck or 5 pounds	25 pounds.
White arsenic or Paris green	¼ pound	1 pound.
Sirup or molasses	1 pint	2 quarts.
Water	3 or 4 quarts	15 to 20 quarts.

(1) Thoroughly dry mix the poison with the bran. This is important, as each particle of bran must carry a little poison in order to get a good kill. When making small quantities mix the bait in a bucket with a paddle, adding the poison slowly and stirring the bran at the same time. A more effective way is to mix the poison and the bran with the hands, but as soluble arsenic to a slight extent is absorbed through the pores of the skin, there may be some objection to this method. If the hands have any cuts, scratches, or other wounds, do not put them into the bait. When making large quantities, the poison can be mixed with the bran on some flat, smooth surface, using a shovel and rake in much the same way as in mixing concrete.

(2) Mix the sirup with the water.

(3) Add the water and sirup solution to the mixture of bran and poison, stirring slowly all the time. Large quantities of water added at one time will wash the poison from the bran, resulting in an uneven mixture.

Caution.—Add only enough liquid to make a crumbly mass. It is a good plan to set aside a little of the mixture of dry bran and arsenic so that if too much water has been used this reserve can be added to bring the mixture to the proper consistency. Large quantities can be made up in galvanized-iron or wooden washtubs, and small quantities in buckets or similar containers.

How and when to use the bait.—Either broadcast the poisoned bait or sow it by hand along the rows or about the base of the plants late in the evening so that it will not dry out to any great extent before the worms become active. Because cutworms overwinter in the ground, it is a good plan to broadcast the poisoned bait over the cultivated areas a few days before the crop comes up or is set in the field. Where plants are to be transplanted to the field, this method is particularly valuable. If hills are made for melons or tomatoes, apply the bait directly to the hills a few days before the crop is set in the field. Such applications will rid the field of many of the worms before the crop is subject to attack.

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[3] Prepared by W. H. White, Entomologist, Division of Truck-Crop Insects, Bureau of Entomology.

Quantity of bait to use: 10 to 15 pounds of the wet bait is sufficient for one application per acre. Where the bait is applied directly to the rows or hills, a smaller quantity will suffice. It may require two or three applications at intervals of two days to rid the field of the pests.

PLANT LICE AND OTHER PESTS

Plant lice or aphids sometimes attack the lettuce crop. These pests can best be controlled, especially on the young crop, by dusting with nicotine dust containing 2 per cent of nicotine. Apply the dust when the air temperature is above 70° F. and when the foliage of the plants is dry. Dusting operations can be more effectively carried on when there is little air movement. The dust should be applied so that it will reach the under side of the leaves of the plant, where the insects feed in the greatest abundance. This can be accomplished by using a duster equipped with a nozzle attachment which will direct the dust upward as it is discharged from the machine. The nozzle should be held near the ground so that the drifting dust will come to rest on the under side of the leaves. Nicotine dust should be applied to the crop not later than 10 days before harvest.

Several other kinds of insects, among which are the lettuce looper and general feeders such as army worms and wireworms, occasionally become troublesome. Up to the present time no entirely satisfactory method has been developed for the control of these pests, although arsenical treatments will control leaf feeders such as the lettuce looper, such treatments are not recommended on crops with edible foliage, except when the crop is in the earliest stages of development.[4]

DISEASES

Lettuce drop, due to a fungus, causes the stem of the plant to rot near the surface of the soil, presenting a soft water-soaked spot that spreads downward until the roots are decayed and at the same time working upward until the bases of the leaves are affected. This results in cutting off the water supply of the leaves, causing them to wilt and drop downward until finally the entire plant collapses. The disease develops rapidly in relatively cool, moist weather. The causal fungus may live for a year or more in the soil. It may withstand deep covering, but remain dormant within 1½ inches of the surface. Soil sterilization is the usual remedy in greenhouses, but in the field where this is impracticable clean culture and crop rotation are about the only methods of controlling the disease. Among the crops recommended for rotation with lettuce are sweet corn, tomatoes, potatoes, cucumbers, radishes, beets, spinach, and onions. Celery and cabbage should not be grown either with lettuce or in the rotation.

Anthracnose is another disease attacking lettuce and is found on all varieties. The causal fungus is known to survive the winter in diseased refuse left in lettuce fields. Rotation of crops is the best way to prevent this trouble.

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[4] For further information on the control of lettuce pests, consult the Bureau of Entomology of the United States Department of Agriculture.

Lettuce frequently suffers from a disease known as downy mildew. Crop rotation and the eradication of wild lettuce from the fence rows and near the lettuce field is recommended.

Damping off of the small lettuce plants, especially in the seed bed, is due to any one of a number of fungi. The symptoms of this trouble are a decay of the plants at the surface of the soil and a falling over of the plants themselves. Sterilizing the soil used in the seed bed, keeping the plants reasonably dry, and giving sufficient ventilation to keep the air fairly dry is the treatment usually recommended for the control of this disease. As a means of avoiding damping off of the plants, the soil used for the seed bed should be reasonably light and of a type that will dry readily. The fact that this disease causes losses only in the presence of an excess of moisture makes it possible to control it largely by the means already suggested. Crowding the plants too closely in the plant bed, thus preventing their drying readily after watering, is one of the most frequent causes of loss from damping off. Where plants are grown in flats or trays they can be watered by setting the trays in a shallow tank in which there is about 1 inch of water, thus permitting the water to rise in the soil from the bottom of the trays without wetting the surface.

There are numerous other diseases of lettuce such as bacterial wilt, rosette, marginal blight, bacterial rot, and mosaic. Tipburn of lettuce, which is considered a physiological disease, is very prevalent in certain varieties, especially Big Boston. Climatic conditions are largely responsible for losses from tipburn. Certain varieties are more resistant to tipburn than others.[5]

PREPARATION FOR MARKET

Lettuce intended for long-distance shipment for the most part is packed without washing; that intended for local marketing is washed and drained before packing. Eastern-grown outdoor lettuce which is shipped in carloads is packed almost entirely in the field. Western head lettuce is largely packed in central packing houses.

Under favorable conditions the greater part of a crop of lettuce can be harvested at one cutting, but it is often necessary to go over the field three or four times, each time cutting only the heads that are matured. The different cuttings, however, may usually be made within two or three days of one another. The maturity of lettuce is determined by both color and solidity. Immature heads are spongy and do not hold up well during transit and marketing. It frequently happens, however, that head lettuce matures and is at its best before the heads are solid. The solidity of the heads at maturity also depends to some degree upon variety. Heads of reasonable firmness and good quality should not be confused with those that are overgrown and which begin to form an enlarged core as shown in Figure 18. Heads that have begun to shoot to seed on account of overmaturity or hot weather are bitter, coarse, and of poor quality.

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[5] Lettuce growers who suffer any considerable losses to their crops from diseases should write to the U. S. Department of Agriculture or to their State experiment station regarding the specific disease and its control.

The common practice of lettuce growers is to distribute the crates or hampers along one side of the field and begin cutting at that point. Cutting is usually done as early in the morning as possible. Heads that have been frosted in the field should never be handled while in that condition. The first 10 or 12 rows of lettuce are cut and packed, and the containers are loaded upon the wagons or trucks for hauling to the car. Another section of 7 to 12 rows is then cut and packed and the trucks or wagons driven directly through the field for loading. In harvesting the lettuce the heads are cut close to the ground or slightly below it. As the heads are cut and slightly trimmed, they are packed directly into the containers or thrown into a window from which they are packed. In some cases, the cutters trim the heads, removing all discolored leaves and turning them upside down where cut. The packers immediately follow the cutters and pack the lettuce in the crates before it suffers from exposure. This system has the advantage that one man not only can pack behind two cutters but can do the work a little better than where the cutters do the packing themselves.

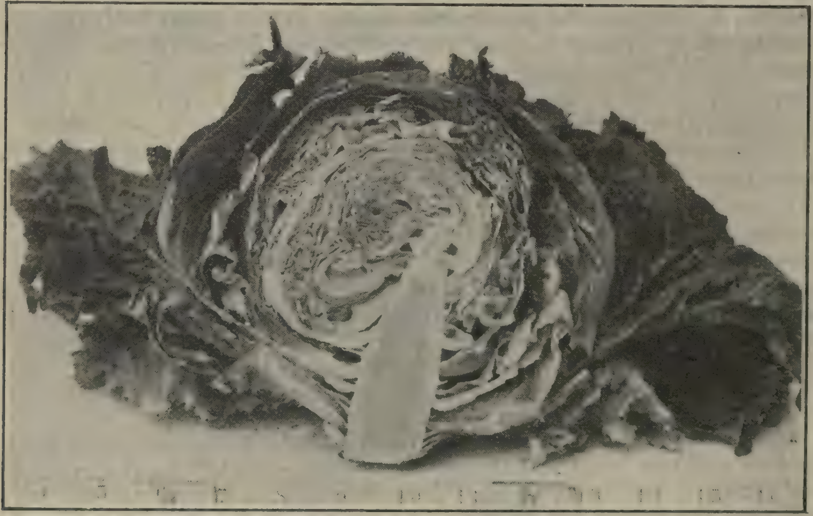

FIGURE 18.—Cross section of head of lettuce, showing enlarged core due to overmaturity

If not packed in the field, the heads are placed rather loosely in lug boxes or large crates and hauled from the field to the central packing houses.

Lettuce that is packed in the field can seldom be graded as uniformly as in a central packing house. The preference for field packing in the eastern districts is based largely on economy and expeditious handling; however, much depends upon the care exercised by the workers. Before packing, the heads are inspected and if necessary are given additional trimming to remove any dirt or undesirable leaves and to give the cut portion of the stem a neat, white appearance. The outer leaves are then slightly drawn together or folded over the head, and the heads are crowded just enough in the packages to make a firm but not tight pack. Although most of the outer leaves are finally trimmed off before the heads are offered for sale, these outer leaves protect the head in transit. Heads that are trimmed too closely and do not have the outer leaves for protection should be discarded or placed in separate containers and marketed locally.

The United States Department of Agriculture has formulated standard grades for head lettuce which each year are being used more extensively.[6]

Lettuce is marketed in packages of various styles and sizes.[7] The major portion, however, is handled in three types of containers, namely, the flat or New York crate, the large or western crate, and the hamper. Most of the crop grown in New Jersey and New York is marketed in the flat crate illustrated in Figure 19, the inside dimensions of which are 19 by 16 by 7½ inches, and which accommodates 24 medium-sized heads. A large part of the Florida crop is packed in hampers of 28 and 32 quarts capacity. The greater part of the western-grown lettuce is packed in large crates the inside dimensions of which are 12½ by 18 by 22 inches, and which hold 36 to 60 heads, dependent upon the size.

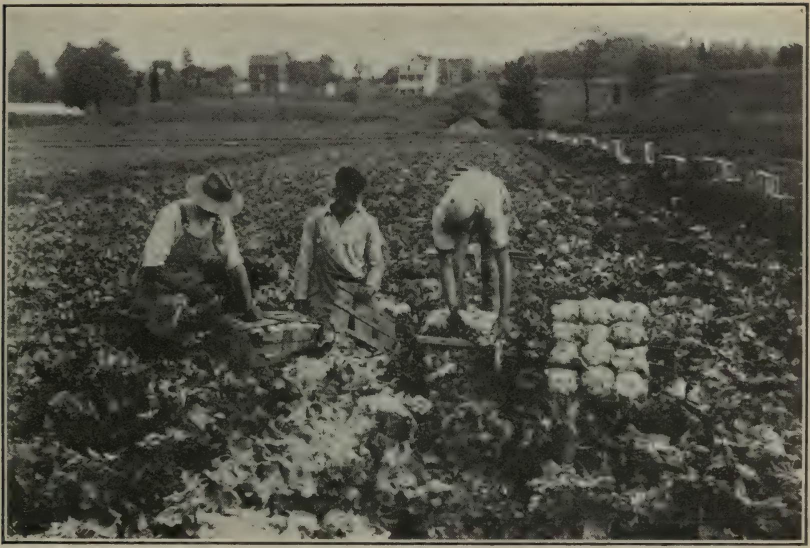

FIGURE 19.—Packing lettuce in the 2-dozen crate, sometimes called the New York crate

In packing the small or flat crate the lettuce is placed in two layers, each consisting of 12 heads. The bottom layer is placed with the stems down and the top layer with the stems up. If the heads are too small to make a tight pack with 12 in each layer, the number to the layer is increased, but in either case they are arranged in definite rows rather than in a jumble or irregular pack.

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[6] These Federal grades may be subject to slight revision from time to time and therefore are not given here. Copies may be procured without charge from the Bureau of Agricultural Economics, U. S. Department of Agriculture.

[7] Information on marketing lettuce is contained in the following publication and also in State publications: HAUCK, C. W. MARKETING LETTUCE. U. S. Dept. Agr. Bul. 1412, 45 p., illus. 1926.

Before being packed, the large or western crate is lined with heavy paper so placed as to lap over the top and the bottom, completely inclosing the contents after the crate is filled. The heads are usually packed in three layers, stems uppermost, each layer consisting of 12 to 20 heads, according to the size. A shovelful of finely crushed ice is placed between the layers, 20 to 30 pounds being used in each crate. This pack should be so tight that the cover slats will bulge about 1 inch. Where ice is placed in the crates, the work of packing must necessarily be done in a packing house, the lettuce being hauled in lug boxes from the fields to the packing house.

In packing lettuce in hampers, the bottom layer, usually consisting of three heads, is placed with the stems down, the second layer with the stems up, each succeeding layer being alternated, but with the top layer packed with the stems up. With medium and large heads of Big Boston 24 to 40 heads can be packed in a hamper with 7 or 8 heads in the top layer; with smaller heads the number varies and the top layer is increased to 9 or 11 heads. When the packing is completed and before lidding, the top layer should extend about 1½ inches above the top of the hamper. In clamping on the lid the hamper may be slightly jarred and the lid pressed down even with the top. (Fig. 20.)

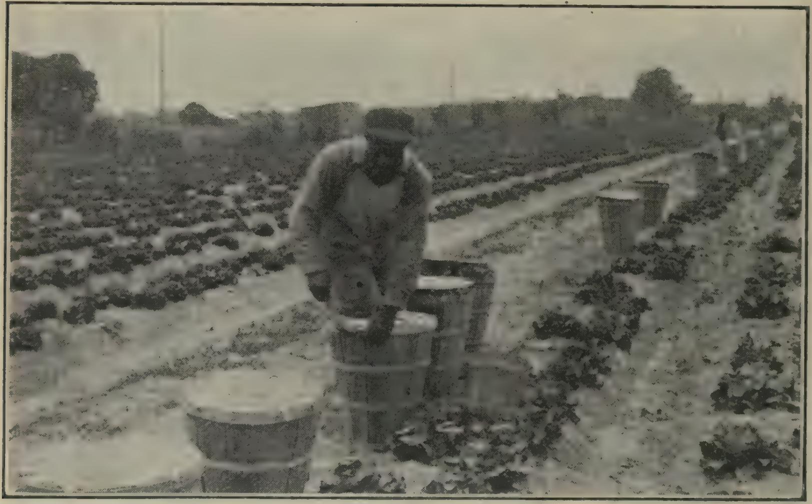

FIGURE 20.—Packing and lidding hampers of lettuce

Lettuce is a perishable crop and requires extreme care in handling. To avoid exposure to sun and wind after the cutting and packing of the lettuce, the crates or hampers should be loaded upon trucks or wagons, covered with a light canvas, moved directly to the shipping point, and loaded into the cars. Lettuce that is to be packed in a central packing shed should be hauled to the packing shed promptly after it is cut, and there should be no delay in having it crated and placed under ice. Care in handling the heads, both in packing and in icing, is essential to prevent bruising. Rough handling of the crates after they are packed should also be strictly avoided. Where the crates or hampers are packed in the field they are usually marked with the grade and the shipper's number by means of rubber stamps carried by the man doing the lidding. In some cases the crates or hampers are marked by the packers. Where the lettuce is packed in a central shed the marking is done by the packers or by the inspectors prior to placing the crates in the cars.

Transcontinental shipments of lettuce from the Imperial Valley of California take from 9 to 14 days to reach the large eastern markets, 10 or 11 days being the average time required in transit. Top or body icing, which consists in spreading a large quantity of broken ice over the top of the load in the car, is being employed in most cases, either with or without standard or bunker icing, depending on the time of the year. As a matter of fact, the greater part of the California crop of lettuce which moves during the winter months is loaded without initial bunker icing but with heavy top icing. Transportation companies have reconditioned many of their refrigerator cars, providing them with waterproof floors to meet the conditions brought about by top icing. Shipments from Arizona and Colorado moving at other times of the year from those of California require different treatment as to refrigeration, some of these shipments being loaded with initial icing in the bunkers of the cars without top icing, while later in the season when the cars must pass through high-temperature territory both bunker and top icing are employed.

The lettuce growers of the eastern United States have a shorter haul to the large consuming centers, enabling them to take advantage of market conditions and to get their produce to market without heavy refrigeration expense. However, even with the shorter distances it is essential to employ every means for keeping the lettuce cool and to avoid subjecting it to exposure.

MARKETING LOOSE-LEAF LETTUCE

Nonheading or leaf lettuce is grown in a limited way as an outdoor crop for local marketing, the Grand Rapids and Early Curled Simpson varieties being used mainly for this purpose. The Grand Rapids variety is grown very extensively in greenhouses, especially in Michigan, Indiana, Ohio, western Pennsylvania, and western New York, and is often shipped to the larger markets in solid carloads during the late fall, winter, and early spring months.[8] Most of the greenhouse lettuce, however, is handled by express and by motor trucks. Leaf lettuce is sold mainly by the pound, and has been marketed in the past in 14-quart and 22-quart square-cornered splint baskets holding from 6 to 10 pounds, in standard bushel round-stave baskets holding 15 pounds, in standard 3-bushel barrels, and in used sugar barrels.[9]

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[8] For a more complete discussion of greenhouse lettuce, see the following publication: BEATTIE, J. H. Op. cit.

[9] UNITED STATES LAWS, STATUTES, ETC. [STANDARD CONTAINER ACT.] U. S. Statutes at Large, pt. 1, p. 685–687. (U. S. Congress, 70th, 1st sess., Public, 462.) 1928. (Also published in the United States Department of Agriculture, Bureau of Agricultural Economics. Rules and regulations of the Secretary of Agriculture under the United States standard container act of 1928. U. S. Dept. Agr., Bur. Agr. Econ. Serv. and Regulat. Announc. 116, 5 p. 1928.)

Considerable quantities of loose-leaf lettuce are grown in coldframes during the early spring and sold locally to stores and consumers. The greater part of this lettuce is handled in crates, bushel baskets, or in bushel boxes which are returned to the grower.

SOME ECONOMIC ASPECTS OF LETTUCE PRODUCTION

The cost of production of lettuce varies with the locality, but under nearly all conditions it is comparatively high. Satisfactory yields can be obtained only on the best soils. The crop requires the application of large quantities of fertilizers, and hand methods must be largely employed, resulting in high labor costs. The average yield of lettuce the country over is about one hundred and sixty 4-dozen or western crates to the acre, but cases are on record where yields of five hundred to seven hundred 4-dozen crates (one thousand to one thousand four hundred 2-dozen or eastern crates) to the acre have been obtained. The average farm price during the period from 1925 to 1928 was approximately $1.56 a crate. On account of periodic overproduction of lettuce, the markets have frequently been oversupplied, resulting in prices below cost of production and transportation. The fact remains, however, that many growers are reaping a fair return from the production of lettuce.

Lettuce is grown on a large scale in about 15 States, but the greater part of the carload shipments is produced in 10 States. The period from 1920 to 1928 has witnessed a considerable increase in lettuce production, largely in California, Colorado, and Arizona. California alone shipped more than 33,000 cars of lettuce in 1928, or almost two-thirds of the entire movement for the country.

Future profits from lettuce growing, in both the Eastern and the Western States, will depend upon a careful adjustment to market requirements and a more thorough grading of the product. Present market conditions apparently do not warrant an expansion of the industry in any section, but there is ample opportunity for a marked improvement in quality and pack.

With the enormous increase in the production of western head lettuce and the flooding of the markets east of the Rocky Mountains with this product at prices often barely above cost of packing and transportation, the market season for the eastern grower has been largely reduced to the periods when the supply from the West has been light. Despite this fact, however, lettuce growing in the Eastern States during the last few years has been more profitable than in the Western States. According to the California Department of Agriculture, the packing and delivery costs of head lettuce in that State for 1927 were $2.45 a crate above the actual cost of growing,[10] but the records show that a considerable quantity of the crop for the year 1926 sold below that figure. The heavy production for the State, however, which was during the period from October to May, brought the general average of about $3.50 per crate.

Growers of the eastern United States are now producing occasional good crops of New York and Iceberg lettuce, which are marketed at a profit during periods of high prices. The eastern grower, whose market is in the East or Middle West, has a decided advantage over his western neighbor from the standpoint of transportation, which on the product from the Imperial Valley of California is approximately $1.70 a crate.

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[10] ROGERS, S. S. FUTURE PRODUCTION OF HEAD LETTUCE IN CALIFORNIA. Calif. Dept. Agr. Mo. Bul. 16: 44–50, illus. 1927.

Considerable progress has been made during the last few years in the development of strains and varieties that are especially adaptable to local conditions. This is particularly true in the Imperial Valley of California, where a disease-resistant strain known as Imperial No. 2 is rapidly replacing the older variety, known as New York but sometimes called Los Angeles and Imperial. The Imperial No. 2 requires a longer period for its development than New York, and for that reason New York is being used mainly for early plantings. High-quality production and rigid standardization are necessary in order to maintain and develop the demand for lettuce.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

October 26, 1929

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DAIRY FARMING FOR BEGINNERS

By J. B. Shepherd, *Associate Dairy Husbandman, Division of Breeding, Feeding, and Management, Bureau of Dairy Industry*

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"SHALL I GO into dairy farming?" is a question many persons are asking themselves. Whether or not a man decides to make dairying his life work or to change from his present occupation to this business depends on the answers he makes to such questions as: Will I find dairy farming profitable? Will it pay well enough to justify making a change from my present occupation? Will I enjoy the work? Am I fitted for this type of farming? Would my present or my prospective location prove adaptable for efficient and economic production of dairy products? Is there a suitable market and a good demand for these products?

This bulletin attempts to present the factors which the prospective dairyman should consider in his efforts to answer these questions.

Dairy farming as a business has many features to commend it.

It is a year-around business. It furnishes a steady labor market at all seasons.

Cash receipts are regular and frequent, providing for current expenses, for financing farm operations, and for systematic saving.

High-producing dairy cows furnish a home market and large returns for hay, grain, silage, soiling crops, and root crops.

The manure, if properly preserved and applied to the land, aids in maintaining the fertility of the soil.

Many farmers favorably situated, therefore, will find the business a profitable one.

Dairy farming, however, is exacting in its requirements, and intelligent planning and well-directed efforts are necessary to make it a success.

It requires a liking for dairy cattle, the ability to give proper attention to details, a willingness to work long hours, and a temperament that is not easily discouraged. A larger investment for buildings is necessary than with some other types of farming.

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The fact that dairying is a 365-day-a-year occupation often renders it irksome. The dairyman has no holidays and vacations except when he is able to obtain a competent substitute.

In summer, dairying and crop raising conflict. The dairyman must feed and milk his cows, care for his equipment, and handle his products every day. Cropping and general farming operations must proceed much as on other farms. This makes for long hours in the day's work. It is sometimes difficult to obtain competent help at this time, although the dairy farmer has some advantages in hiring help, because he can offer a year-around job.

Any person contemplating going into dairying will do well to study it from all angles in order to determine whether or not it will be a practical and profitable business for him to undertake.

The prospective dairyman must consider other factors in connection with dairy farming. The first of these are a satisfactory market, the adaptability of the farm for dairying, and capital for dairy buildings, equipment, and the dairy herd. Next come problems incident to the planning, construction, and equipment of buildings, growing of feed crops, and selection of the foundation herd. When the dairyman has established his herd on the farm he faces many problems of dairy-herd management.

A SATISFACTORY MARKET

There must be an established market for dairy products or positive assurance that such a market will be established by the time it is needed. The principal markets are wholesale and retail market milk, creameries, cheese factories, and condenseries. In some localities ice-cream factories furnish a market for limited quantities of whole milk and sweet cream.

MARKET MILK

Where the dairyman can take advantage of them, retail milk routes and city milk-distributing plants to which market milk is sold wholesale usually furnish the best-paying markets. Usually he will obtain twice as much for his milk by retailing it as by selling it wholesale. He must, however, deduct the expense for equipment, supplies, and labor for pasteurizing, cooling, bottling, storing, and delivering the milk. The net profits, therefore, may not be so great as in selling milk wholesale. Before retailing or selling milk wholesale to a distributor consult the local health officer or board of health concerning the regulations regarding dairy barns, milk houses, manure disposal, and the handling of dairy products.

CREAMERIES, CHEESE FACTORIES, AND CONDENSERIES

Everything considered, there is on an average little difference in the net returns from marketing dairy products through creameries, cheese factories, or condenseries. Condenseries and cheese factories can use only sweet whole milk, necessitating delivery at least once a day, and in many places twice a day for a part of the summer. By selling his product to the creamery the dairyman greatly reduces the bulk and weight to be delivered and also the number of trips to be made where he has facilities for holding the cream at a low temperature. The cost of hauling, therefore, is greater for the condensery and cheese factory than for the creamery.

The condensery usually pays a higher price for the product than does the creamery or cheese factory, but the difference may be partially or wholly offset by the feeding value of the skim milk which remains on the farm when the dairyman sells his product to the creamery or the feeding value of the whey which remains when he sells the milk to the cheese factory. Approximately 85 pounds of skim milk or whey is left for each 100 pounds of whole milk. The whey is usually available to the farmer who cares to haul it away from the cheese factory.

The dairyman can determine the relative returns obtained from different methods of marketing dairy products in his section by comparing the prices paid to local farmers by dairy concerns doing business in that section. If he feeds skim milk and whey on the farm he should add the value of these to the value of the dairy products sold.

FEEDING VALUE OF SKIM MILK AND WHEY

Skim milk contains practically all the nutrients of whole milk except the butterfat. It is an excellent feed for growing calves, growing and fattening pigs, growing chicks, fattening poultry, and laying hens.

The cash value of a certain quantity of skim milk or whey when fed on the farm in properly balanced rations is fully equal to the market value of such amounts of other feeds as have the same feeding value. For calf feeding, approximately 10 pounds of dry skim milk or 10 to 12 pounds of the commercial or home-mixed calf meals will take the place of 100 pounds of fluid skim milk. For pork production 100 pounds of skim milk has a feeding value equal to approximately 11 pounds of corn plus 7 pounds of tankage. For feeding laying hens, 100 pounds of skim milk will take the place of 15 to 20 pounds of meat scrap. Only sweet skim milk should be fed to calves, but either sweet or sour skim milk may be fed to hogs and poultry.

Whey is poorer in feed nutrients than skim milk, lacking not only the butterfat of whole milk but most of the protein also. It is largely a hog feed, being used only to a limited extent as a calf and poultry feed. Its value for pork production, however, is only about one-half as much as that of skim milk. In calf feeding it is best not to feed the whey alone; better results are obtained by adding some milk. Experiments conducted in Denmark indicate that 100 pounds of whey to which 25 pounds of skim milk has been added will produce approximately the same body weight in calves as 100 pounds of skim milk. Whey can be advantageously used for moistening poultry mashes. Its value as a feed for poultry is considerably less than that of skim milk. Before the whey is hauled from the factory it should be pasteurized, put into clean cans, and then fed while still fresh and wholesome.

ADAPTABILITY OF THE FARM FOR DAIRYING

To be suitable for dairying, the farm should be fertile; it should be sufficiently large to permit the growing of both feed crops and cash crops; it should be located conveniently to dairy markets; and it should have an abundant supply of pure water.

Dairy cows require large quantities of feed. Fertile soil makes it possible to produce these at a low cost. A sufficient acreage in good pasture reduces the quantities of other feeds required and lowers the cost of the ration by allowing the cow to harvest a part of her own feed. The prospective dairyman should estimate carefully the crop-producing capacity of the farm so that he will not make plans for too large a herd. Unless a special dairy market is available it is usually advisable to add to the farm income by growing some cash crop that is especially suited to the section in which the farm is located.

To make it possible to deliver dairy products easily and economically, the farm should be located on a good road close to town or to a shipping point or on a milk or cream collecting route.

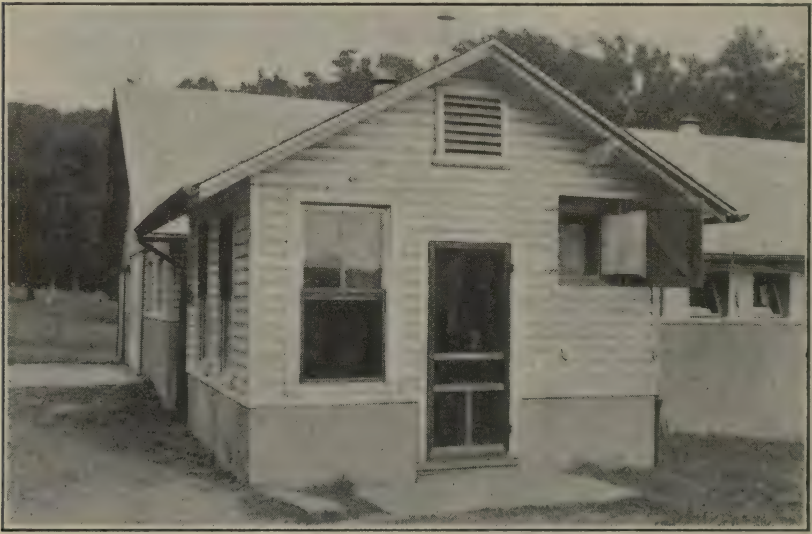

FIGURE 1.—Good type farm milk house

CAPITAL FOR THE DAIRY ENTERPRISE

Many dairymen have failed financially because of a lack of sufficient capital, the too liberal use of credit, or the unwise expenditure of money in the management of the enterprise. Provide adequate buildings and equipment and a suitable foundation herd at a minimum of expense. If cash funds are limited, do not employ credit too extensively. It is always better to begin with a small herd than to go too deeply into debt.

PLANNING, CONSTRUCTION, AND EQUIPMENT OF BUILDINGS

The buildings usually required are a dairy barn, milk house, silo, manure pit, and an ice house in regions where natural ice can be harvested. The bull and young stock are often housed in a separate shed or barn.

Some dairymen house their cows in a 1-story barn and keep the feed in a separate building. A silo is desirable to provide succulent feed during the winter and during the summer when pastures are short and dry. A manure pit is needed to preserve the manure, so that there will be little loss in fertilizing value before it can be spread on the land. Every dairy farm should have a milk house, (fig. 1), in which to care for the dairy utensils and to cool the milk or cream quickly after milking and keep them cool in a storage tank of ice water or cold running water until delivered. The milk house should be sanitary but need not be expensively constructed.

Plan the construction and arrangement of the buildings before starting work on them. In planning the arrangement, consider present needs and future expansion. Proper sanitation and adequate light and ventilation are all important and play a part in the health of the herd and the production of clean milk.

The type and cost of suitable dairy buildings depend upon climate, cost of materials, labor, and other conditions as they exist on each farm. In cold climates, deeper foundations and warmer and therefore more expensive buildings are required than in warm climates. (Fig. 2.) On some farms the dairymen can provide buildings by remodeling other buildings. (Fig. 3.)

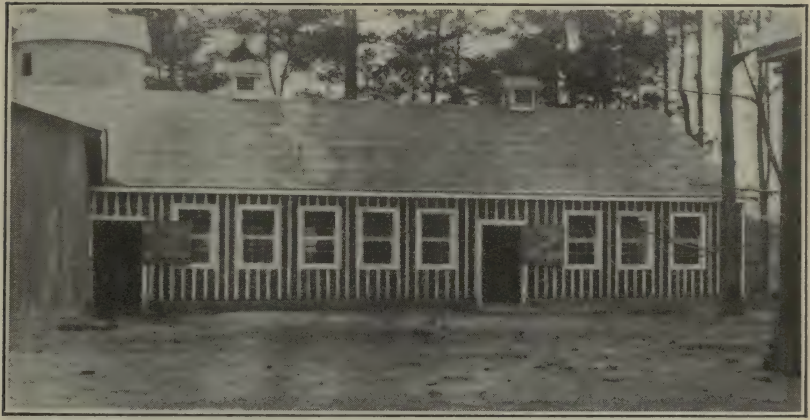

FIGURE 2.—Practical one-story dairy barn suitable for a warm or moderate climate

Dairy barns and milk houses should be adequately and economically equipped. The equipment should be durable, easy to keep clean, and suited to the purposes for which it is to be used. It should provide for the comfort and health of the animals, convenience in performing the work, and clean milk production, essentials of which are well-sterilized utensils, clean cows, and properly cooled milk held in storage. Careful methods of production have by far the greatest influence on the quality of the product.

GROWING FEED CROPS

In most cases home-grown feeds are cheapest and best. Plan a large enough acreage to provide sufficient pasture, silage, hay, and grains. Purchase only the high-protein mill feeds required to balance the home-grown grains. An abundant supply of good cheap feed is important for the ecomonical production of milk and butterfat. (Figs. 4 and 5.) Crops suitable for dairy cattle are grasses and some of the legumes for pasture; corn, the sorghums, milo, kafir, corn and soy beans, peas and oats, and other mixtures for silage; legumes or a mixture of a legume and a nonlegume for hay; and soy beans, oats, corn, barley, kafir, and miscellaneous small grains for concentrates. Select the crops and the best varieties of these crops adapted to the locality. Plan a regular rotation of the crops that will aid in building up the fertility of the soil and that will supply the quantities of these feeds needed.

The quantity of feed required for each cow varies with her size and production. As a general rule, the averaged-sized cow that is on pasture during the summer will require almost 2 tons of hay or 1 ton of hay and 3 tons of silage yearly. High-producing cows require from 1 to 2 tons of grain, or even more per year, according to their production. The yearling heifer requires small quantities of grain and about one-half as much pasture and roughage feeds as a mature cow. It is always a good plan to provide a little surplus of roughage feeds. Any feed not consumed can be carried over to the next season.

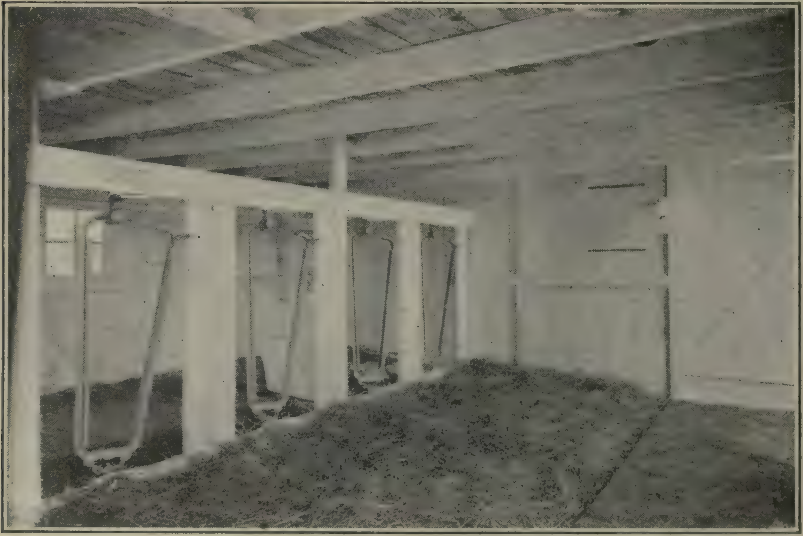

FIGURE 3.—Some farm barns can be transformed into satisfactory dairy barns at small expense

SELECTION OF THE FOUNDATION HERD

There are several dairy breeds in the United States, all of which are giving satisfaction. Before deciding which breed to buy, consider such factors as the breed predominating in the locality, personal preference, and market requirements for dairy products. Good cows and poor cows are found in all breeds. The selection of the individual cow is more important than the selection of the breed. Do not cross breeds as the characteristics of both will be so mixed in the offspring that they will not be passed down to future generations with any degree of certainty.

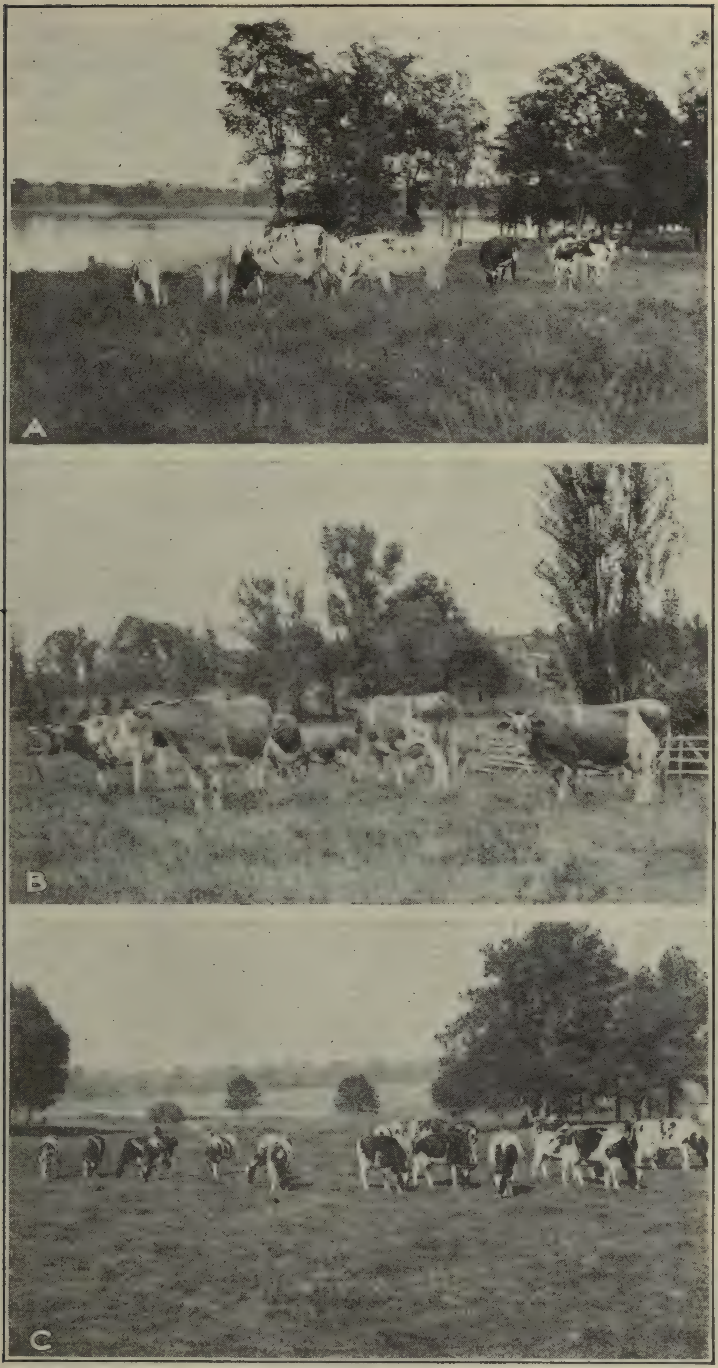

FIGURE 4.—Good pastures cut down feed and labor costs: A, Ayrshires; B, Guernseys; C, Holsteins

The importance of selecting healthy animals can not be overemphasized. It is easier and cheaper to buy such animals than to get rid of diseases, once they have gained a foothold in the herd. Purchase only guaranteed breeders, which are subject to physical inspections as to general health and to approved tests for tuberculosis and infectious abortion. In shipping animals from one State to another, comply with the regulations of the State livestock sanitary boards with regard to health certificates and shipping rules.

FIGURE 5.—An abundance of home-grown feeds makes economical production possible; A, Cutting alfalfa for hay; B, Harvesting corn for silage

THE FEMALES

Regardless of the breed chosen, the best practice for the beginner with little experience is to start with a small herd of young, healthy, high-producing grade cows of good conformation. Avoid buying barren or shy breeders or cows with injured or diseased udders. Purchase purebred females from time to time as finances permit. By following this plan for a few years and raising the most promising heifers from the highest-producing cows, you will have a good-sized herd of high-producing animals at a low cost.

If the dairyman has had considerable experience and commands a sufficient working capital, it may be advantageous for him to include a large percentage of purebred females in his foundation herd, especially if he intends to make a business of selling purebred stock for breeding purposes. The initial cost of purebreds will be higher than that of grades and therefore the risk will be greater, and the care and management will require more knowledge and skill.

The age at which foundation females should be purchased depends upon the needs of the individual farmer. Bred heifers usually cost less than older cows. Cows 3 to 5 years old that are known to be good producers and regular breeders and have sound udders will give larger immediate returns than either old cows or bred heifers. Old cows should not ordinarily be purchased unless they are especially valuable breeding stock and can be obtained at a comparatively low price.

The dairyman usually can purchase cows capable of high production or well-bred young stock in the older dairy sections and also from well-established dairymen in other sections. He can not select such cows with certainty on the basis of general appearance alone. Actual milk and butterfat records made under normal conditions are the best indication of the cow's ability to produce. Fortunately, a large number of cows in the United States are being tested for production on a yearly basis. Dairy-herd-improvement-association records show the yearly production of milk and butterfat, cost of roughage, cost of grain, gross income, and average income over cost of feed for each cow in the herd. These records are kept by impartial testers and serve as an excellent guide in the selection of foundation stock. In addition, production records are being kept on many purebred herds by the herd-test plan and by advanced registry and register-of-merit tests.

THE BULL

From the standpoint of herd improvement the bull is the most important member of the dairy herd. His influence on the calf crop is as great as that of all the cows combined. This influence will be good or bad, according to whether he transmits high or low production to his offspring. He must, therefore, be selected with great care.

In the first place, the bull must be a purebred. He should be a well-grown individual as shown by his size and vigor, and he should be so bred that the chances are favorable for his having the ability to sire daughters of high average production. His ability to sire such daughters can be determined only after he has a sufficient number of daughters with records that can be compared with the records of their dams. The best bull to buy, therefore, is a mature bull of proved ability. (Fig. 6.) Unfortunately, the number of such bulls that have been proved in this way is limited, and they are often either not available or are prohibitive in price. Until such time as bulls are proved in large numbers, most breeders must of necessity select unproved bulls.

When a young bull is selected he should be a son of a sire whose transmitting ability for production is known to be good. His dam should be a good producer and preferably a daughter of a good proved sire. The better the cows in the herd, the better the herd sire must be if the production of the future herd is to be maintained or increased.

Most farmers do not like to keep bulls after they reach maturity because of a possibility of their becoming dangerous. You can manage an older bull without danger, however, if you provide the right kind of quarters and breeding pen. Keep the bull until his daughters have completed a lactation period and his transmitting ability has been thereby determined. Many of our best sires have been killed before their transmitting ability was known. These sires might have been kept in service many years longer. Had this been done the herds in which they were used and the breed as a whole would have benefited correspondingly. Prove your sire before he is slaughtered.

FIGURE 6.—A purebred sire of proved ability whose daughters averaged considerably higher in production than their dams

In sections where herds are small and there is a concerted movement toward the establishment and improvement of dairy herds, the services of good bulls may be obtained at the lowest cost by means of a cooperative bull association. This is a farmers' organization formed for the purpose of joint ownership, use, and exchange of high-class purebred dairy bulls. The members are divided into three or more groups of neighboring farmers, each group being known as a block. A block may consist of one herd or several herds and contain from 50 to 75 cows. One bull is assigned to each block. In order to prevent inbreeding, each bull is moved to another block every two years. If all the bulls live and are kept until each has made one complete circuit, no new bulls need to be purchased for six or more years, or as long as these bulls continue to be serviceable. During this time each member will have had the use of a high-class purebred bull. You can obtain further information concerning the cooperative bull association from your State agricultural college or from the Bureau of Dairy Industry, United States Department of Agriculture, Washington, D. C.

DAIRY-HERD MANAGEMENT

KEEPING HERD RECORDS

To obtain accurate and detailed information concerning your herd keep herd records. The system of keeping records need not be elaborate but should be complete enough to furnish accurate information on the production of individual animals, quantity and kinds of feed eaten, and breeding data. These records are an aid in feeding cows according to known production, detecting sickness or any abnormal condition, culling out low-producing cows, building up the future herd through the selection of heifers out of high-producing cows, and determining the ability of the herd bulls to sire daughters of merit. Herd-record books, milk sheets, and other blank forms necessary for keeping such records can be procured for a small sum.

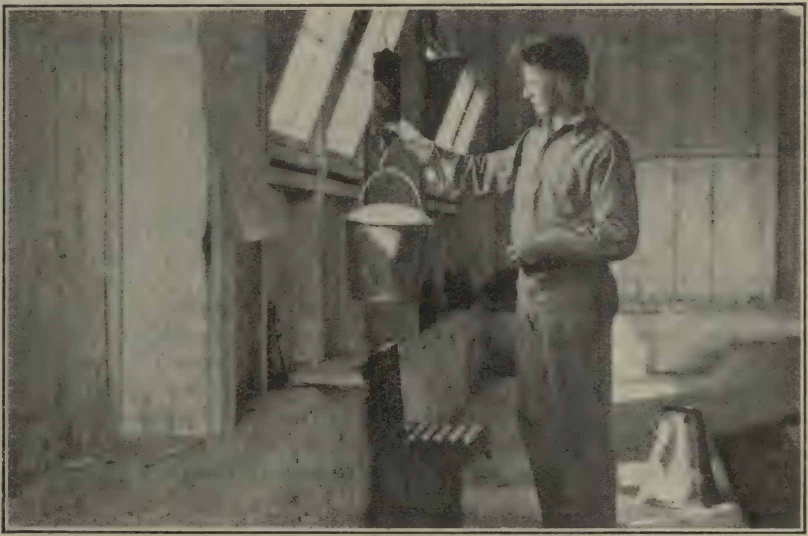

FIGURE 7.—Weighing and recording milk. The case contains samples of each cow's milk to be tested for percentage of butterfat

Production records are obtained by weighing each cow's milk daily, testing her milk at regular intervals for percentage of butterfat, and calculating the quantity of butterfat produced. (Fig. 7.) Feed records are obtained by weighing the quantities of feed consumed. The grain should be weighed at each feeding. The hay and silage need be weighed only occasionally.

Dairymen themselves may keep feed and production records of their cows, or they may join a dairy-herd-improvement association and have this work done by the association tester. Thousands of farmers have found the latter a cheap and reliable method for keeping such records. The national dairy-cattle breed associations, in cooperation with the State agricultural colleges, maintain systems of official and semiofficial testing for purebred dairy cows; and some have adopted plans for herd testing whereby yearly records of entire purebred herds may be more cheaply obtained. Write to the agricultural college in your State for information regarding the organization and operation of dairy-herd-improvement associations and the rules and requirements for official testing and the herd-testing plan.

Calving records enable the dairyman to breed the cow at the proper time. It is good dairy management to breed each cow so that she will freshen once every 12 months. This allows for a 10 or 11 month milking period and a 1 or 2 month dry period. On the day that the cow is bred a record should be made of the date of breeding, the name of the bull to which she is bred, and the probable date of calving. Breeding records eliminate guesswork as to calving dates and permit the dairyman to dry up the cow a reasonable length of time before she is due to freshen. Such records also indicate the extent of any breeding difficulties that may arise.

Follow a plan of identification and the registration of purebred animals. Proper methods of identification eliminate guesswork regarding the identity of the members of the herd. Assign a number to each animal in the herd and to each newborn calf. These numbers are attached to the animal by means of stamped metal tags attached directly to the ear; stamped metal or fiber disks fastened with hog rings to the upper part of the ear; or by means of stamped metal tags attached to a leather strap placed around the animal's neck. Tattooing numbers and letters in the ear is practiced by some breeders and is required by some breed associations in connection with registration and official testing.

Register all purebred young stock promptly. The national dairy-cattle breed associations furnish directions and advice for registering purebred cattle. The names and addresses of these associations are as follows:

American Guernsey Cattle Club, Peterboro, N. H.
American Jersey Cattle Club, 324 West Twenty-third Street, New York City.
Ayrshire Breeders Association, Brandon, Vt.
Brown Swiss Cattle Breeders Association, Beloit, Wis.
Holstein-Friesian Association of America, Brattleboro, Vt.

COST OF KEEPING THE DAIRY COW

Studies made by the Bureau of Dairy Industry on the unit cost of producing market milk in different sections of the United States showed that on an average the cost of feed, including pasture, was about 50 to 55 per cent of the total cost. The cost of labor averaged about 20 per cent of the total. The remaining 25 to 30 per cent of the total expense was for the following: Dairy supplies, charges for the use of dairy buildings and equipment, interest on the investment in the dairy herd, livestock taxes and insurance, veterinary services, medicines, disinfectants, dairy-herd-improvement-association costs, and depreciation in the value of the animals in the herd because of old age, disease, and accidents. The value of the calves and the manure for fertilizer. on the other hand, was equal to 15 to 25 per cent of the cost of keeping the dairy herd. The total cost of keeping a dairy cow, as well as the different items of expense, however, varies considerably in different sections of the United States and under different conditions of feeding and management.

The average productive life of a cow is from five to seven years. A sufficient number of heifer calves of good breeding should be raised for replacement purposes.

Although the expense of keeping the herd should be kept as low as possible, the saving of a little money in some instances may result in the loss of large sums. For example, there is no economy in saving feed by underfeeding good dairy cows, for such cows will return a larger profit if liberally fed according to known production than if considerably underfed. As another example the value of the information obtained concerning the herd will more than repay the dairyman for the small cost of joining a dairy-herd-improvement association. The records will show, for instance, which are the low producers. By culling these from the herd the dairymen will be able to save the feed which they would have consumed.

LABOR REQUIREMENTS

Due to the conditions existing on each farm, there is a wide variation in the amount of man labor required to handle a dairy herd. In a study of the cost of milk production on 48 Wisconsin farms made jointly by the Bureau of Agricultural Economics, United States Department of Agriculture, and the University of Wisconsin, it was found that the amount of man labor averaged 171 hours per cow for the year, or 28 minutes per day. This labor included milking, feeding, caring for utensils, and cleaning the barn. It did not include hauling manure from the barn, delivery of milk, or caring for young stock. On some of the farms the time spent was as little as 20 minutes per cow per day and on other farms it was as much as 45 minutes. Producing milk of high quality requires very little more labor than producing milk of medium or low quality. Large herds require less labor per cow than do small herds. A convenient arrangement of barns and milk houses; the use of equipment, such as feed and litter carriers, power-operated cream separators, and milking machines; and the employment of efficient labor all help to cut labor requirements to a minimum.

STORIES DAIRY-HERD-IMPROVEMENT-ASSOCIATION RECORDS TELL

The production and feed records of dairy-herd-improvement associations contain a wealth of information relative to feeding and management practices. The Bureau of Dairy Industry has made a study of these records on a large scale. Many of the facts ascertained are of vital importance to the dairyman, especially to the beginner. A few of the studies made are discussed here in a brief way.

The purebred dairy cows of this country produce more milk and butterfat than do grade cows when both are kept under similar conditions. A study of over 100,000 yearly individual-cow records show that the average purebred cow produced 10.6 per cent more milk, 6.7 per cent more butterfat, and returned 9.7 per cent more yearly income over feed cost than did the average grade cow.

A study of over 100,000 yearly-individual cow records show that the highest-producing cows are the most profitable. As production increased the value of product, total feed cost, and the value of product over feed cost increased, whereas feed cost per pound of butterfat decreased. (Table 1.) These figures show that the increased production more than offsets the extra feed cost and indicate that it pays to feed good cows liberally according to known production.

TABLE 1.—*Relation between butterfat production and other factors*

Production of butterfat	Value of product	Cost of feed	Income over cost of feed	Cost of feed per pound butterfat
Pounds	*Dollars*	*Dollars*	*Dollars*	*Dollars*
107	58.85	45.28	13.57	0.42
203	109.69	55.29	54.40	.27
299	163.57	67.80	95.77	.23
397	220.47	82.30	138.17	.21
496	277.68	99.77	177.91	.20
596	344.66	121.50	223.16	.20

A study was made to show the influence of 500 purebred dairy bulls when mated with cows in dairy-herd-improvement associations. Each of these bulls had five or more daughters, whose records were compared with those of the dams of the daughters. It was found that on an average the daughters produced 5.3 per cent more milk and 11.8 per cent more butterfat than their dams. A study of these records also showed that, although most purebred bulls are able to increase the production of daughters over poor and medium producing dams, only the best purebred bulls can be relied on to increase the production of daughters over high-producing dams.

The time of year that a cow freshens has an influence upon the production of milk and butterfat, amount and cost of feed consumed, and income over feed cost. As a rule, cows freshening in the fall and early winter produce more and yield a larger income over cost of feed than cows freshening at other times of the year. A cow that is dry too much of the time does not produce as much and is not as profitable as she would be if she were dry only long enough to prepare for the coming lactation period.

WHERE TO OBTAIN INFORMATION ON DAIRYING

Information on dairying may be obtained from your county agricultural agent, State agricultural college, and the Bureau of Dairy Industry, United States Department of Agriculture, at Washington, D. C. This information is available in the form of bulletins and circulars covering different phases of dairying. The Bureau of Dairy Industry and many of the State agricultural colleges also have available plans for dairy barns, milk houses, etc.

There are many excellent dairy textbooks that are valuable for study and reference and several good dairy-farm journals and dairy-breed journals that discuss topics of interest to the dairyman. A list of these and the names of the publishers will be furnished by the Bureau of Dairy Industry to those who desire them.

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For sale by the Superintendent of Documents, Washington, D. C. - - - - - Price 5 cents

OATS IN THE WESTERN HALF OF THE UNITED STATES

By T. R. Stanton, *Senior Agronomist*, and F. A. Coffman, *Associate Agronomist, Office of Cereal Crops and Diseases, Bureau of Plant Industry*

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IMPORTANCE OF THE CROP

LESS than one-tenth of the annual oat crop of the United States is produced in the western half of the country. Oats, however, constitute the second most important cereal grown in this region. With the development of western agriculture, interest in the crop is increasing. In most of the region where the crop is grown yields and grain quality both are good. The crop is grown primarily to complete rotations and to meet feed requirements for domestic animals on farms. The high nutritive value of oats as feed for horses, dairy cattle, sheep, and growing animals is fully appreciated by stockmen throughout this region. In the almost complete absence of corn production in many sections, oats constitute one of the important concentrated feeds for farm animals. Oat straw also is of considerable value in some sections as roughage for horses and cattle.

OAT AREAS

On the basis of climatic and other environmental factors, the vast territory lying west of the ninety-eighth meridian, or geographically the western half of the United States, may be divided into the Great Plains area, the Rocky Mountain and intermountain area, and the Pacific area. (Fig. 1.)

Within each of these areas there are several oat sections, more or less distinct. In both the Great Plains area and the Rocky Mountain and intermountain area there are dry-land and irrigated sections. The Great Plains and Pacific areas each contain a rather definite section in which the red-oat varieties are grown almost exclusively. In the Pacific area there are sections in which oats are grown from both fall and spring seeding.

THE GREAT PLAINS AREA

The Great Plains area is that territory lying between the ninety-eighth meridian and the foothills of the Rocky Mountains and extending from Canada to southern Texas. This outlines the territory only in a general way but with reasonable accuracy. This area comprises the western parts of the Dakotas, Nebraska, Kansas, Oklahoma, and Texas, and the eastern portions of Montana, Wyoming, Colorado, and New Mexico. The altitude ranges from slightly below 1,500 to more than 5,000 feet. The topography for the most part is slightly rolling, although great sections are comparatively level. The general outline of the area is shown in Figure 1.

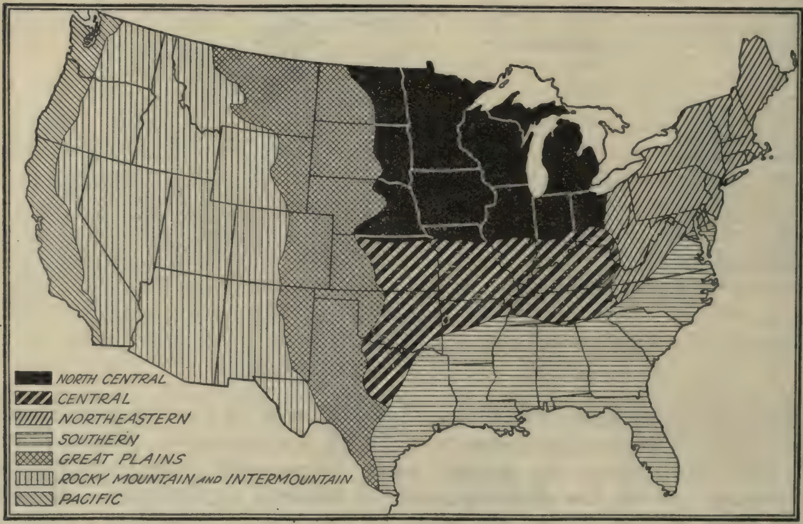

FIGURE 1.—Outline map of the United States, showing the general oat areas. In the southern and Pacific areas the crop is grown from both fall and spring seeding. In all other areas the crop is grown from spring seeding only. The southern area is known also as the winter or fall-sown area. Likewise the central area is often designated as the spring-sown red-oat area

The climate of the Great Plains area is widely fluctuating and rigorous. Crop production in this entire territory is more or less hazardous, and crop failures frequently occur. The rainfall varies widely from season to season, but averages less than 20 inches annually over the greater portion of the area. The distribution of the seasonal precipitation is more often the determining factor in oat production than is total annual precipitation.

The oat crop uses water rather freely and often fails because of drought. In the northern section frosts and even snowstorms occur occasionally early enough in the fall to damage oats before they are harvested, sometimes resulting in severe crop losses. Hailstorms cause heavy local losses in many sections. In the southern section hot winds are of frequent occurrence in summer and often injure oats and other cereals.

Throughout this area moisture as a rule is the limiting factor in crop production, and as a consequence every possible means should be utilized to store sufficient moisture in the soil to mature a profitable crop. Extensive investigations are being conducted by the Office of Dry-Land Agriculture, Bureau of Plant Industry, United States Department of Agriculture, to determine the most satisfactory rotations to make the growing of oats and other cereals more certain and profitable in this area.

ROCKY MOUNTAIN AND INTERMOUNTAIN AREA

Briefly, the Rocky Mountain and intermountain area includes all the territory extending westward from the eastern foothills of the Rocky Mountains to the western foothills of the Cascade Range and the Sierra Nevada Mountains on the west. It embraces most of the area of the so-called Western Mountain States, including the western parts of Montana, Wyoming, Colorado, New Mexico, and Texas, the whole of Idaho, Utah, Nevada, and Arizona, and the eastern parts of Washington, Oregon, and California. Because of the mountainous character of these States their agriculture naturally is confined to the river valleys, bench lands, and plateaus. In most sections the annual rainfall is relatively low, and where sufficient water is available irrigation farming has been extensively developed. Many of the valleys have been brought under irrigation, resulting in the development of a flourishing agriculture in which oats are an important cereal crop.

In this section oats are grown at elevations varying from 2,000 to more than 6,000 feet above sea level.

In the early development of agriculture in this area oats, wheat, and other crops were grown to some extent under dry-land conditions, and frequent crop failures resulted. With the development of irrigation and an assured water supply for plant growth the culture of oats has increased greatly, and as a result the crop has become of much more importance than formerly. Higher yields are obtained under irrigation in this area than in any other area of the United States. The quality of the oats produced also is unsurpassed.

PACIFIC AREA

The Pacific area embraces a comparatively narrow strip of territory bordering on the Pacific Ocean and extending from Puget Sound in Washington to Lower California. It constitutes an oat area more or less distinct. Owing to the rather generally favorable climate for oats, the crop is grown in some sections from both fall and spring seeding. As a rule, extremes in temperature rarely occur, except in the great interior valleys of California, and usually there is sufficient precipitation for crop production.

Owing to the favorable climate, the production of oats in the Pacific area is greater than the total production for the Rocky Mountain and intermountain area and the Great Plains area combined. In the Puget Sound and Olympic Peninsula sections of Washington oats are extensively grown, constituting the most important cereal crop. In certain districts of these sections acre yields exceeding 100 bushels are obtained.

In California, oats are grown principally in the central coast district and in the Sacramento and San Joaquin Valleys. Owing to the warm climate of these great interior valleys, oats are less satisfactory than under the cool and more moist conditions of the coast sections. Hot and dry weather during the heading and ripening period frequently is detrimental to the crop. In recent years the unfavorable weather conditions have been offset or neutralized to some extent at least by growing earlier varieties such as Fulghum and Kanota.

SOILS

The soils of a territory as large as the western half of the United States naturally must vary greatly in type, productiveness, and topography.

The soils of the Great Plains area vary from heavy clays to almost pure sands. Most of the land which has been brought under cultivation in this area ranges through the silt loams and clay loams to heavier types. Such soils are fairly well adapted to the production of oats. In some sections the accumulation of alkali in the soil has made crop production almost impossible. Throughout this area moisture rather than fertility or texture is more frequently the limiting factor in crop production. Successful production of oats depends largely upon the ability of these soils to retain moisture and their proper handling for its conservation.

In the Rocky Mountain and intermountain area most of the alluvial river valley soils are well adapted to oats. The soils of river bench lands and uplands of this area are mostly silt or very fine sandy loams, and they produce excellent crops of oats when sufficient moisture is available either through natural rainfall or irrigation. Porous. gravelly soils, under either irrigation or dry farming, are least satisfactory for oats, owing to their poor water-holding capacity.

The silt and clay loams of the Pacific area, particularly those of western Oregon and Washington, are capable of producing excellent crops of oats. The greater rainfall and lower summer temperatures, rather than a difference in soils, make conditions generally more satisfactory for oats than they are outside of irrigated sections in the two areas previously mentioned.

MANURES AND FERTILIZERS

In general, the arable soils of the Great Plains have shown little decrease in fertility since being brought under cultivation. A considerable quantity of readily available plant food usually is present in these soils. Deficient rainfall and frequent light crops have reduced soil fertility less rapidly than in sections where rainfall is more abundant and where larger crops draw more heavily on the soil. Under the latter conditions there also is greater loss by leaching and erosion.

In the Great Plains commercial fertilizers are not necessary. Even barnyard manure seldom is used. Heavy applications of manure are likely to cause heavy early growth and final loss from crop burning. If manure is used it should be spread lightly to obtain benefit without injury.

In the Rocky Mountain and intermountain area, as in the Great Plains area, practically no commercial fertilizer is used on oats or other cereal crops. Barnyard manure is not used under dry-land farming for reasons similar to those given for the Great Plains. Under irrigation, manure is applied to some other crop in the rotation. On some of the older irrigated soils where heavy cropping is rapidly decreasing native fertility, light applications of manure, if available, can be made with profit. Under irrigation, however, oats make a rank growth and may lodge. It seldom is advisable to apply manure directly to oats.

In some sections of the Pacific area which have been farmed for many years, as for example the Willamette Valley, commercial fertilizers may pay. Barnyard manure should be applied to some other crop in the rotation, such as corn, kale, or potatoes, increased yields of oats being obtained as a residual effect.

Commercial fertilizers, while still little used in this area, should prove profitable in oat production on the soils of the longer settled sections. Ordinarily, where commercial fertilizers pay, an application of 150 to 200 pounds per acre of superphosphate (acid phosphate) is one of the best treatments for oats. Under some conditions a complete fertilizer—that is, one containing phosphorus, nitrogen, and potassium (potash)—may be more satisfactory. Commercial fertilizers, however, should be used in this area only when there is some assurance of a return on the investment.

ROTATIONS

The discussion of rotations under dry-land and irrigated conditions is more or less applicable to both the Great Plains and the Rocky Mountain and intermountain area. Under dry-land conditions the major factor in any rotation is the proper conservation of the limited precipitation as available soil moisture for the crop. Under irrigated conditions, with an abundant water supply, crop rotation is of less importance from this standpoint.

DRY-LAND SECTIONS

Dry-land farming is associated largely with the Great Plains area, yet it is followed to a considerable extent in the Rocky Mountain and intermountain area on bench lands and high plateaus which can not be irrigated. In reality, dry-land farming originated in the latter area and spread thence to the Great Plains. The methods of farming in both sections, therefore, are similar. The fallow system is largely followed under dry-farming conditions. In some sections the land is fallowed one year and cropped to some small grain, usually wheat, the next. In other sections two annual crops are grown after one year of fallow. In still other sections small grains and corn or potatoes are grown in alternate seasons. As a consequence, less oats are grown in the Great Plains area than in the areas to the east.

Results of extensive investigations in rotation methods conducted by the Office of Dry-Land Agriculture, Bureau of Plant Industry, United States Department of Agriculture, indicate that oats, like wheat, are most productive when grown on fallow. However, fallow may not be the most profitable method of production. Crop-rotation plots at the Dickinson Substation, Dickinson, N. Dak., are shown in Figure 2.

The Great Plains area extends over so wide a territory that a rotation especially suitable for one section may not be the best for another. Regardless of the rotation, oats will yield much better on the average in the northern than in the southern part of the area. As a crop, oats use more water to produce a pound of dry matter than does any other cereal. As a consequence, they must be sown early in the spring for best results. This requires that they follow a crop which leaves the soil in such condition that it can be quickly prepared for spring seeding. As in sections farther east, oats follow corn more successfully than any other crop. As oats do not draw heavily on soil fertility, wheat can be grown after oats with good results. In the central part of the Great Plains area a popular rotation is the growing of corn and small grains in alternate years. This rotation probably gives the greatest return for the least expenditure of labor of any followed in this area.

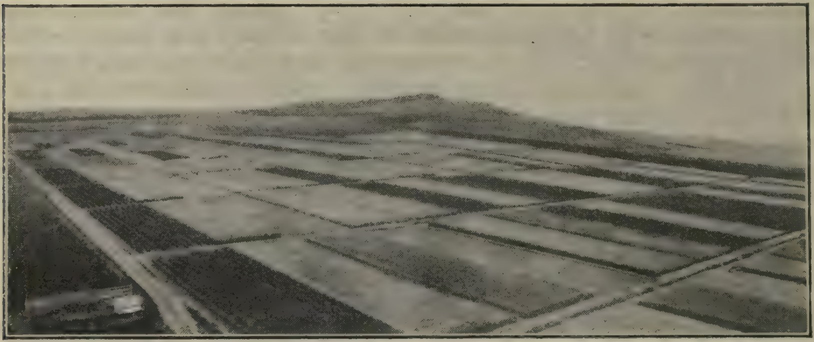

FIGURE 2.—Crop rotation experimental plots at the Dickinson Substation, Dickinson, N. Dak., in 1923

In the southern part of the Great Plains area grain sorghum replaces corn, but the rotation otherwise is much the same as in the corn-producing sections. In western Oklahoma and Texas some oats are grown in rotation with cotton.

In the northern part of the Great Plains area oats often follow wheat. Oats sometimes are grown to give the soil a change from continuous wheat farming. Next to corn ground, wheatland, especially when spring plowed, apparently is one of the best for oats in the Great Plains area.

In some sections of the Great Plains oats are used as a cover crop for sweetclover or bromegrass sown in the spring. The oats are removed from the ground early enough to permit the sweetclover or grass to make a fair growth in the late summer and early fall.

The cropping systems used on the dry lands of much of the Rocky Mountain and intermountain area are similar to those already described for the Great Plains. The substitution of corn, field peas, alfalfa, etc., for fallow is less common in this area. As a consequence, oats are grown on fallow in the Rocky Mountain and intermountain area more frequently than in the Great Plains area.

IRRIGATED SECTIONS

In irrigated sections grain crops often are the first crops sown on new land. They are the easiest crops to grow immediately after clearing and leveling the land. Irrigated farming, as a rule, is intensive farming, while cereal production is not generally so considered. Cereals generally are the least profitable crops to grow on well-leveled, highly productive, irrigated land. The oat crop is less profitable than wheat, and oats are not used in rotations under irrigation so often as wheat.

Rotations which are followed in irrigated areas in Colorado[1] and Idaho[2] include the following: Alfalfa, three years or more; sugar beets or potatoes two or three years; and cereal crops for two or three years, the cereal being used as a nurse crop for alfalfa in the last year. In another rotation clover instead of alfalfa is grown for two years, beets or potatoes for two years, and a cereal crop one year. The land is then cropped to clover again. In Utah a cereal crop often is used following alfalfa in the rotation.

HUMID SECTIONS

In the Pacific area crop rotation is more diversified than in either the Great Plains area or the Rocky Mountain and intermountain area. Here a greater number of crops are grown, and oats occupy about the same position in rotations as in the humid Eastern States. Oats frequently are sown as an intermediate crop between row crops and clover. A common rotation for this area is a row crop, such as corn or potatoes, followed by oats and clover each one year. Where vegetables are grown for the production of seed, or other special row crops are produced, oats frequently are used as an intermediate crop for seeding to clover. In California less attention is given to crop rotation than in western Oregon and Washington. Where oats are grown in this section they usually are included in rotations along with wheat and barley.

Oats are less influenced by the preceding crop than are wheat or barley. For this reason most rotations are arranged to meet the special requirements of other crops, oats usually occupying the less-favored position. The adaptability of oats gives the crop a flexibility that allows it to work well in almost any rotation.

SEED-BED PREPARATION

In the following paragraphs methods of seed-bed preparation under dry-land, irrigated, and humid conditions are treated separately. Both on dry land and under irrigation special methods are required.

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[1] CARLETON, M. A. THE SMALL GRAINS. P. 423. New York. 1916.

[2] AICHER, L. C. GROWING IRRIGATED GRAIN IN SOUTHERN IDAHO. U. S. Dept. Agr. Farmers' Bul. 1103, 28 p., illus. 1920.

DRY-LAND CONDITIONS

With the exception of being grown after fallow, oats are grown most successfully following a row crop. Corn or sorghum leaves the soil in comparatively good condition to be prepared for oats. As these are row crops, the soil has been cultivated during the previous year and usually is less infested with weed seed than when it has been cropped to small grain. A seed bed also can be prepared with a minimum of tillage expense.

A common practice in preparing corn or sorghum ground for oats is first to break down the stalks or stubble. This can be done best by dragging a heavy pole or an iron rail across the field in the winter, when the ground is frozen. If the ground is frozen, the stalks will snap off much more readily than when temperatures are higher and the soil is soft. A stalk cutter also may be used to reduce the stalks. It is not necessary to rake and burn the stalks. The organic material added by a crop of stalks usually is beneficial even in the Great Plains area. Any organic material is useful in checking soil blowing.

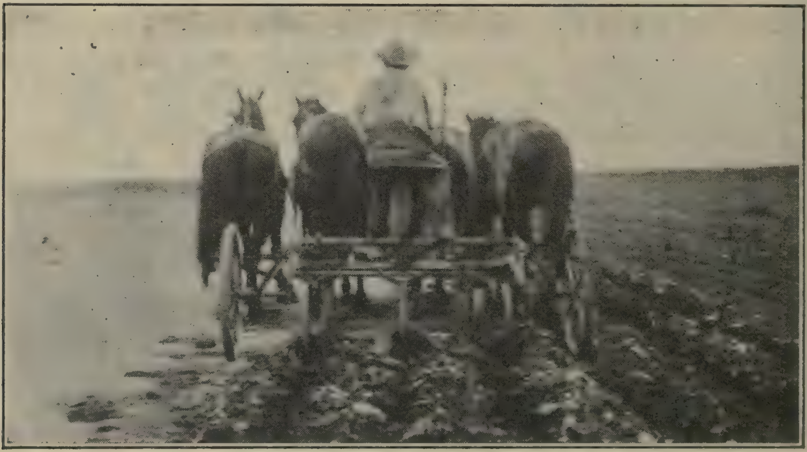

FIGURE 3.—Preparing a seed bed on dry land with a duck-foot cultivator

After the stalks have been broken the ground may be prepared by disking. Usually it is necessary to double disk the ground in order to break up the soil held by the corn or sorghum roots. The land also may be prepared with a duck-foot cultivator, an implement which is becoming very popular under dry-land conditions. (Fig. 3.)

Oats usually give the best results if the seed bed is composed of not more than 3 to 4 inches of loose soil on the surface and is firm beneath. This condition usually can be obtained by disking the ground twice. A very satisfactory method is to lap disk the ground; that is, to lap half on each round. This leaves the ground more nearly level than if it is cross disked. The disks should be sharp to insure cutting the stalks. The disks should be set to penetrate the soil 3 to 4 inches. The tandem disk is being used more and more in this area for preparing the seed bed for oats and other small grains. After disking, the ground may be leveled with a spike-tooth or other smoothing harrow. In Figure 4 is shown a disk harrow being used to level land which had been ridged to prevent soil blowing.

Although it is a more expensive method of preparing the soil, experiments conducted at several of the field stations of the United States Department of Agriculture in the Great Plains area have shown that oats will produce better yields if sown on spring-plowed land. However, this usually is too expensive a method of preparing the seed bed to be practicable for oat growing in this area.

IRRIGATED CONDITIONS

On land previously cropped and already comparatively level, a good seed bed for oats can be prepared by fall plowing the land and leaving it rough over winter. The natural lumps resist soil blowing to a considerable extent. Land that is spring plowed can be worked down sufficiently for a good seed bed, but it requires considerable packing. This can be done by using land rollers, packers, or even a disk harrow, the disks of which are set straight. Usually it is well to level irrigated land each season with a float or drag. This operation helps to keep the surface from becoming uneven after washing by irrigation water or rains.

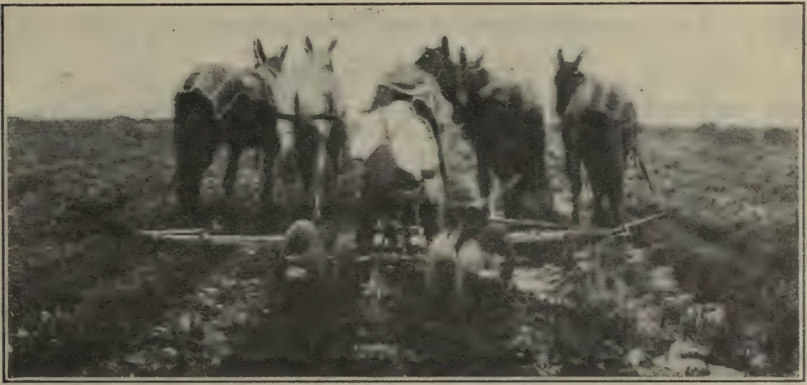

FIGURE 4.—Disk harrow being used in the Great Plains area to level land which had been ridged to prevent soil blowing

HUMID CONDITIONS

In the Pacific area methods of seed-bed preparation are similar to those followed in the North-Central and Northeastern States. Where oats follow corn, potatoes, or some special row crop, such as vegetables for seed production, a satisfactory seed bed usually can be prepared by disking. Plowing usually is necessary where oats follow wheat or barley. To plow the land in the fall and leave it unharrowed over winter is a common practice. Early spring plowing sometimes is practiced because of less danger of loss from soil erosion. Ordinarily fall-plowed land may be fitted for oats with the minimum of disking and harrowing. In this area, as in all others, the best seed bed for oats is one that is firm beneath, with a fine mellow top layer of soil from 2 to 4 inches deep. Methods which will produce these conditions are to be recommended.

PREPARING THE SEED FOR SOWING

CLEANING THE SEED

Oats usually are threshed with an air blast weaker than that for other cereals, because of the danger of blowing the lighter oats away. As a result oats often contain a considerable proportion of trash and weed seed. These impurities should be removed from seed oats.

In fanning and grading the seed the openings in the screens should be sufficiently large to let all small weed seed fall through but not large enough to allow any but the smallest of the oat kernels to pass. The larger weed seed and trash can be separated from the oats by first using a screen with meshes sufficiently large to let the oats pass through but small enough to catch sticks, pieces of straw, etc. Grading seed oats to the point where only the larger and plumper kernels remain is not necessary.

SEED TREATMENT FOR SMUT CONTROL

THE SPRAY METHOD

Place the seed on a clean barn floor or canvas spread on the ground, or in a tight wagon box or header barge. Mix 1 pound of formaldehyde (37 per cent by weight) with 1 pint of water and pour the solution into a quart pump sprayer. Then shovel the oats from one pile to another, spraying each shovelful. One stroke of the sprayer piston should produce sufficient mist for the seed on an ordinary dirt shovel, or four strokes for the seed on a scoop shovel. After the oats are sprayed, shovel them into a pile and cover with blankets, tarpaulins, or sacks which also have been sprayed with the solution. The pile of seed should remain covered at least five hours and may be left overnight without injury. The oats are then ready for bagging and drilling. However, if sowing is delayed, or if it is planned to store the oats for some little time, the pile should be spread out and thoroughly aired for a day or two.

A modification of this method is sometimes used. This is done by mixing 1 pound of formaldehyde with 10 pints of water. The treatment is conducted in the same manner as for the 50-50 solution, except that a heavier mist is applied to the seed. In using any of the spraying methods care must be exercised to prevent irritation of the eyes, nose, and throat by the formaldehyde vapor.

THE SPRINKLE METHOD

The oats are placed in a pile on a clean barn floor or canvas. As the grain is shoveled from one pile to another it is thoroughly sprinkled with a solution made up of 1 pint of formaldehyde (37 per cent by weight) to 40 gallons of water. After the sprinkling has been completed and it is assured that every kernel is wet, the oats should be covered with blankets, sacks, or canvas, disinfected in the same solution, and allowed to remain for at least two hours, or overnight. The sacks should then be removed and the seed spread out to dry, or the oats may be sown immediately on removing the cover. About one-fourth more seed by bulk should be sown to the acre to allow for the swollen condition of the seed.

THE DIP METHOD

Seed oats may be treated also by dipping them directly in the solution. The solution, which is made up the same as for the sprinkle method, is placed in a barrel. The oats are put in burlap bags, which should be neither packed too tightly nor filled too full. The bags are dipped into the solution in the barrel and allowed to remain for several minutes, or until all of the grain is wet. The sack should be moved about somewhat while immersed in the solution, in order to hasten wetting the grain. A good method of agitating the seed is to roll it from one end of the sack to the other. After treatment the sacks should be lifted out and drained on a board laid across the top of the barrel. After draining for a few minutes the oats are poured out of the sack on a clean floor or in a wagon box and handled thereafter in the same manner as in the sprinkle method.

In order to prevent reinfection after treatment, care should be taken to disinfect the bins, sacks, or wagon boxes in which the seed is stored before sowing and the drill box and feed spouts through which the seed is sown. This can be done by spraying them with some of the formaldehyde solution.

Surplus seed treated with formaldehyde may be fed to livestock without injury if thoroughly dried after treatment. By exposing it to the open air for several days all danger will be avoided.

For more complete information on seed treatment of oats for the control of smuts, see Miscellaneous Publication No. 21.[3]

SEEDING OATS

METHODS OF SOWING THE SEED

GREAT PLAINS AREA

Although oats may be sown either by broadcasting or with a drill, the latter method is used almost exclusively in the Great Plains area. Power machinery is much used in this area, and it is not uncommon to see several drills being pulled by a single tractor. This hastens the seeding operation, a very important consideration in growing oats in any section. This is especially true in the Great Plains area, where moisture is likely to be deficient later in the season and early seeding is a very important consideration.

ROCKY MOUNTAIN AND INTERMOUNTAIN AREA

In most irrigated sections of this area the acreage devoted to any one crop is small, yet it has been learned from the experience of the most successful farmers that the sowing of cereals is best done with the drill. Some grain still is sown broadcast, but within recent years the drill has come into more general use, and drilling usually is the method recommended.

PACIFIC AREA

In the Pacific area the drilling of oats is largely practiced, although earlier seeding sometimes can be done by broadcasting.

Under any conditions, drilling permits the seed to be scattered more uniformly than by broadcasting. The seed also is covered at a more uniform depth and usually is placed in moist earth where conditions for germination are more favorable than when the seed is broadcast on the surface and a second operation depended upon for covering. The placing of the seed in moist earth is more necessary under dry-land than under irrigated or humid conditions.

The rate at which oats should be sown will vary with the locality, the date of seeding, the condition and fertility of the seed bed, the purpose for which the crop is intended, the method of seeding, and kernel size. Ordinarily, a slightly heavier rate is used where seeding has been delayed beyond the usual time and less time for tillering remains. On soils likely to become weedy, more seed should be used than on clean soil. Slightly more seed also should be sown on a poorly prepared seed bed. In drilling, less seed is required than when it is sown broadcast. This is because of a greater likelihood of incomplete covering in broadcasting. If the crop is intended for hay or pasture it may be sown at a rate heavier than when it is to be harvested for grain. Where varieties have comparatively large kernels they may be sown at heavier rates than the smaller-kerneled varieties in order to obtain an equal number of plants to a given area. Many experiments have been conducted by the United States Department of Agriculture in the Great Plains area to determine the best rate to seed oats. The results of these experiments seem to indicate that tillering depends very largely on the number of plants to the acre. If the stand is thin usually more tillering will result than if a heavy stand exists, although seasonal climatic conditions may influence tillering to a marked degree. Most often oats are sown in the Great Plains area at rates varying from 4 to 8 pecks per acre, 5 or 6 pecks being the most common rates. The rates of seeding oats in this section usually are not so heavy as in sections farther east, where the rainfall is greater and less danger of drought exists.

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[3] TAPKE, V. F. FORMALDEHYDE SEED TREATMENT FOR OAT SMUTS. U. S. Dept. Agr. Misc. Pub. 21, 4 p., illus. 1928. (Rev. 1929.)

In irrigated sections it is essential that good stands of oats be obtained. This is especially true because of the expense of growing the crop and the comparatively small value of the return it makes. One reason for thick seeding is the elimination of weeds. Some farmers cross drill their land. The distance between the drill rows also is a point of controversy, but as yet no information is available to show that so-called close drilling in rows 4 inches apart has an advantage over the usual drilling in rows 6 to 8 inches apart.

It has been found, however, that where oats are used as a nurse crop for alfalfa or clover they should not be sown too thickly. The oats are likely to choke out the alfalfa or clover. The seeding rate for oats in the irrigated sections varies from 8 to 12 pecks per acre. The average rate is about 10 pecks. When oats are used as a nurse crop the seeding rate ordinarily should be reduced by at least one-fourth.

In the Pacific area the usual rates of seeding are from 10 to 12 pecks per acre, although under the very favorable conditions for oats in western Washington and Oregon, they are sometimes sown at rates of 14 or even 16 pecks per acre. In California the best rate for red oats is about 10 pecks.

DATE OF SEEDING

One of the most important requirements in oat production in any area is that the seed should be sown early in the spring. In the Great Plains area early seeding is extremely important. As a rule, the danger of loss from seeding too early is less than from seeding too late. The injury resulting from late freezes occurring after the seed is sown and some growth has started is less than that from seeding later in the season because of the increased likelihood of hot and dry weather during critical stages of the crop's growth.

The Great Plains area extends over so great an expanse of territory from north to south, as well as from east to west, that the seeding dates necessarily vary considerably. For the entire area the best general recommendation is the earliest possible date in the spring when the ground is in a condition to be prepared satisfactorily and after danger of prolonged cold or of zero weather is past. Cases are on record in the Great Plains area where subzero weather has occurred after oats have been sown and yet little injury resulted.

Most irrigated districts are located at elevations which are comparatively high. As a result, in most of the districts the growing seasons are short and there is danger from early fall frosts if the grain is sown too late. Oats should be sown as early in the spring as possible in irrigated sections as well as on dry farms. Late seeding is not recommended, as in most seasons a decided reduction in yield will result.

In the Pacific area there is great variation in the time of seeding. In western Oregon and Washington most oats are sown as early in the spring as possible. The first week in April is about the average date of seeding for these districts. In the Willamette Valley some oats are sown in the fall, usually during October. In California, oats may be sown at any time from October 15 to February 15. Ordinarily most oats in California are sown in November. Farm practice indicates that the best results usually are obtained by seeding at this time. If sown later, the crop will have less opportunity to escape heat and drought during the ripening period.

CULTIVATION OF OATS

HARROWING

The yield of oats sometimes may be increased by cultivation when the plants are well through the ground. More often such cultivation is not practicable. On irrigated land where the soil is rather loose and cloddy and likely to dry out rapidly, a float or land roller is used sometimes after seeding to firm the soil and make a smoother seed bed. Sometimes an oat field is harrowed in the spring to destroy weeds. Where small weeds are numerous in the crop before the oat plants fully shade the soil, the field may be given a light harrowing with a spike-tooth harrow. This will destroy many small weeds and may pay if it does not injure the oats. To prevent the harrow from damaging the oat plants, the teeth should be thrown back at an angle in order to stir the minimum of surface soil and to destroy the maximum number of small weeds.

WEEDING

Some farmers follow the practice of cutting or pulling large weeds, such as mustard and sunflowers, from their oat fields in order to prevent them from producing seed or interfering with cutting and shocking operations. Some oats will be trampled down in the operation, particularly if the weeds are not removed until late in the growing season, but the grain lost in this way probably will be more than compensated for by the eradication of noxious weeds. Spraying to kill weeds in oats is impracticable.

For information on irrigation of oats and other small grains, including directions on time to irrigate and the quantity of water to apply, see Farmers' Bulletin No. 1556.[4]

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[4] McLaughlin, W. W. irrigation of small grain. U. S. Dept. Agr. Farmers' Bul. 1556, 14 p., illus. 1928.

HARVESTING THE CROP

CUTTING

In the Great Plains area most of the oats have been harvested with the binder. In some portions of this area the header also has been used. More recently the header has been partly replaced by the combine (combined harvester-thresher). Sometimes oats in this territory are cut with a mower. This method is used when the plants are extremely short, on account of heat or drought or severe hail or wind injury, or in cases where so much lodging has occurred that the binder can not be used. Oats sometimes are mowed while yet a trifle green, the object being to feed them in the straw without threshing. If cut in this way the grain may be raked into windrows and later placed in cocks. When handled in this way the grain should be cut before it becomes too ripe, or there may be some loss through shattering. A field of excellent oats in shock in the Grain Plains area is shown in Figure 5.

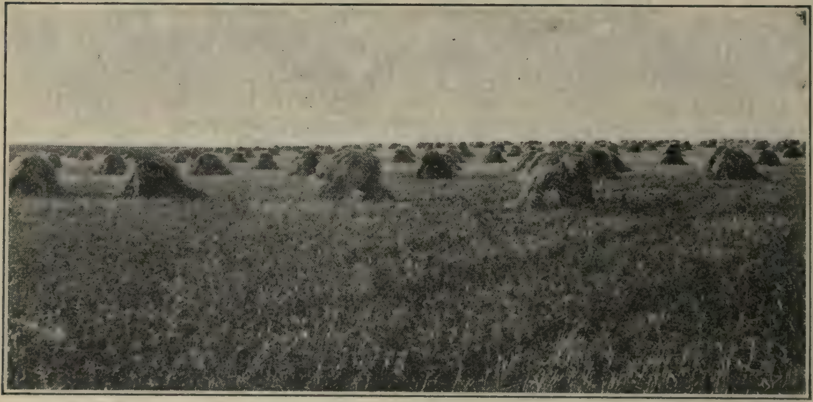

FIGURE 5.—An unusually good crop of oats in shock in the Great Plains area

The method of cutting may determine the stage at which to harvest the crop. If the grain is cut with the binder or the mower, it should be cut very soon after the crop reaches the stiff-dough stage. If the header is used, oats should be cut while in the late-dough stage; but when the combine is used the grain should be allowed to stand until ripe and dry enough to store without danger of loss from heating and moulding in the bin. If there is danger of the grain spoiling after being harvested with a combine it should be spread out on a granary or barn floor to dry. It is common practice in the Great Plains area to spread grain which has been threshed with a combine directly on the ground in the open, often without any protective covering. Usually the loss from this method is not great.

Nearly all oats grown under irrigation are cut with the binder. After the oat kernels in the upper part of the panicle have passed the hard-dough stage the crop is ready for harvest. Irrigated oats should not be cut too soon, in order to obtain full use of available moisture. If the grain is badly lodged, it may be necessary to cut only one way of the field, or even to cut the lodged areas with a mower or by hand with a scythe or cradle. These latter methods are likely to cause considerable loss from shattering. The combine has spread rapidly in other parts of the country and it may have a place in irrigated sections. The small area of the grainfields, however, and the difficulty of crossing dikes and ditches with large machines make the combine less adaptable to irrigated lands. Harvesting irrigated oats with a binder is shown in Figure 6.

SHOCKING

In the Great Plains area and the Rocky Mountain and intermountain area oats should be shocked as quickly as possible after being cut with a binder. The atmosphere here usually is so dry that shattering is liable to result if the grain is allowed to dry out too much or to become thoroughly ripe before being cut and placed in shocks. In both these areas oats usually are shocked in round shocks. Winds are prevalent, and the long shock seldom is used because of the greater danger of its being blown down. Regardless of type, special attention to proper shocking will insure maximum protection from the weather and a better quality of grain.

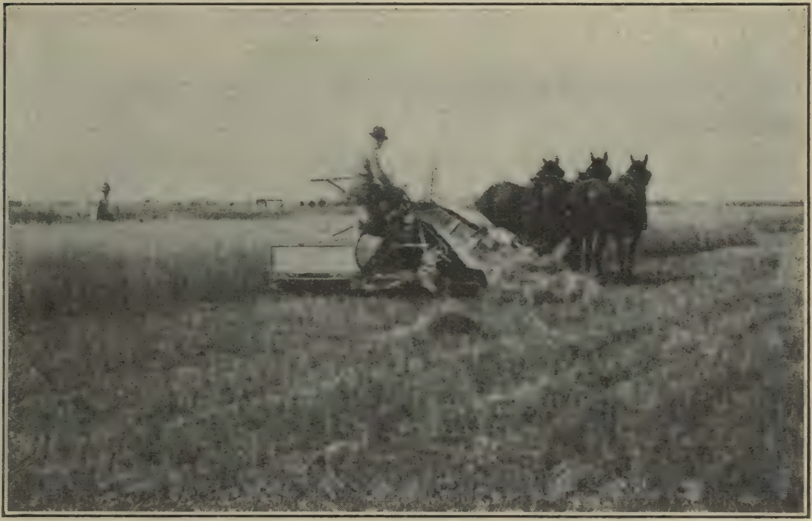

FIGURE 6.—Harvesting irrigated oats with a binder

In the Great Plains area and the Rocky Mountain and intermountain area, as well as in the Pacific area, cap sheaves seldom are used because usually they are blown off by high winds. Greater damage results from their coming in contact with the soil than would result from leaving the shock uncapped. There also usually is no special need of caps, as rain seldom causes much damage during the harvest season. Shocked oats grown under irrigation in Oregon are shown in Figure 7.

STACKING

Oats in the western United States usually are not stacked but are threshed directly from the shock.

In stacking oats under any conditions, whether cut with the binder, header, or mower, it is advisable that the stack ground be well drained. Some farmers follow the practice of plowing the ground and scraping a small mound on which to place their stacks. This practice insures a well-drained stack bottom. In the Great Plains area rainfall seldom is so great as to require the same attention to this phase of stacking as is essential in sections of greater rainfall and humidity. In the Rocky Mountain and intermountain area stacks should be placed where there is no danger of overflow water from irrigation soaking the bottom of the stacks.

It is well to cover the ground with straw, fence posts, or poles to prevent the grain from coming in contact with the soil. Oats usually are stacked in round stacks, although long ricks are sometimes used. Headed grain usually is stacked in rather long, narrow ricks brought to a sharp point in topping. All grain at time of stacking always should be as dry as possible to prevent heating and damage from stack burn.

FIGURE 7.—A field of harvested oats grown under irrigation in Oregon; wheat in stack in background at left and corn in foreground at right

In building up the stack to the height of the bulge, the middle always should be kept full and well tramped. The other rows of bundles should be tramped as little as possible. Likewise, in building the top of the stack, the middle should be kept high and well tramped at all times. Attention to these essentials will insure a distinct downward slope of the straws in the exposed butts of the outer bundles, which is necessary if the stack is to shed water perfectly.

There is much less danger of grain spoiling in the stack in the Great Plains area than in more humid sections. It usually is not advisable to thatch grain stacks with straw or hay to prevent spoiling, although thatching will prevent damage by birds, which seem to be especially fond of oats.

THRESHING

Although in the Great Plains area and the Rocky Mountain and intermountain area the danger of oats being too wet for threshing is not great, it is essential that oats be thoroughly dry before they are threshed. When grain is not dry it is likely to heat and mold in storage. In threshing wet grain the operation is performed less efficiently than when the grain is dry. The danger of delays caused by the clogging of the machinery, the throwing of belts, and by breakdowns is much greater when the grain is wet than when it is dry.

It is very important that the threshing machine should be thoroughly cleaned before starting. It is recognized that noxious weeds, such as fan weed, dodder, morning-glory, and Canada thistle, as well as plant diseases, especially smut of wheat and oats, may be scattered from farm to farm by failure to clean the threshing machine properly after each setting. An oat-threshing scene in western Washington is shown in Figure 8.

Oat straw is superior to the straw of all other cereals as roughage for livestock. West of the ninety-eighth meridian, where the hay crop is often short, it is customary to save oat straw for feeding. If space is available it is well to store the oat straw under cover at threshing time. If stored outside it should be carefully stacked to avoid injury from the weather.

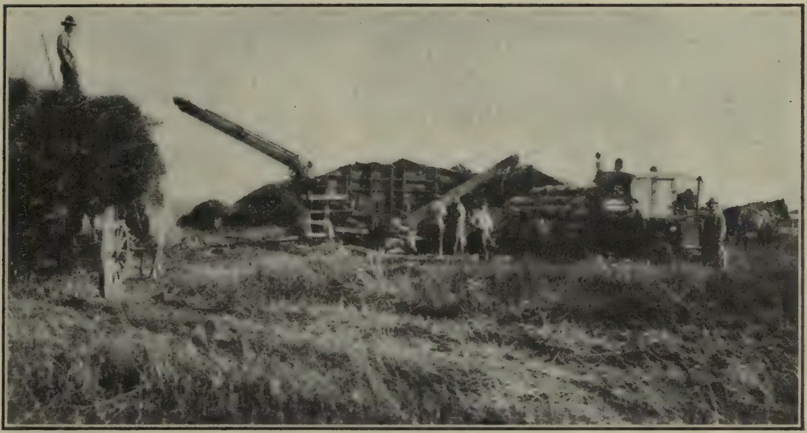

FIGURE 8.—Threshing oats in Skagit County, Wash.

VARIETIES

There naturally is a great deal of variation in the adaptability of oat varieties in so large a territory as the entire western half of the United States. The adaptation of varieties not only differs markedly for each area, but there also is a marked difference in the adaptation within each of these various areas. Generally in the Great Plains area early varieties have been most satisfactory. In the southern section of the Great Plains early red varieties usually are recommended. In the central section early (common) varieties and in the extreme northern section midseason white oats produce the highest yields. Generally, in the Rocky Mountain and intermountain area varieties maturing in midseason under irrigated conditions are the most productive. With an abundance of water the larger and later varieties are decidedly more productive than the earlier, shorter-strawed sorts for growing under irrigation. The longer growing period enables them to use the abundant water supply more advantageously. In the Pacific area there is a still wider variation in the adaptation of varieties. Both fall-sown and spring-sown varieties are grown in western Oregon and Washington. For fall seeding the Winter Turf (Oregon Gray Winter) variety is the most productive. Midseason and late varieties usually are recommended for spring seeding. In California oats may be sown from November to February. In that section the varieties at all well adapted are limited almost entirely to those of the Red Rustproof and Fulghum groups.

VARIETIES FOR THE GREAT PLAINS AREA

Comparatively few varieties of oats are grown in the Great Plains area. Except in the extreme northern part, early oats are decidedly the most satisfactory under the dry climate of this area. The introduction of the early, short-strawed, drought-escaping varieties, Kherson and Sixty-Day, from Russia at the beginning of the present century resulted in making oats a much more certain crop in the Great Plains area. The development of the Fulghum variety also has been a stimulation to oat production in this area, especially in the southern section. The Great Plains may be divided as follows: Southern section, early red oats almost exclusively; central section, early common oats with some early red varieties; and northern section, early and some midseason common oats.

RED OAT VARIETIES

The principal varieties of red oats are Red Rustproof, Fulghum, and Burt. Owing to the later maturity of the Red Rustproof and its various strains, this variety is not especially well adapted to the southern Great Plains. The early varieties, Fulghum and Burt, are the best adapted of all varieties and are to be recommended. Prior to the development of the Fulghum variety, Burt was the leading variety. In recent years Kanota, a strain of the Fulghum, has become of importance and is now by far the most popular variety.

The Fulghum is an early red oat with a small, rather erect panicle. Under dry-land conditions this variety has shown superiority over both the Red Rustproof and Burt varieties. It is possible that by selection still more satisfactory strains can be developed from the Fulghum and possibly from the Burt variety for extremely dry conditions in this section.

EARLY AND MIDSEASON VARIETIES

For the central Great Plains, early varieties such as Kherson and Sixty-Day, including various selections from them, are the most satisfactory, although in many localities Fulghum and its strains also do well. The results of experiments conducted in this area show that the improved strains of Kherson, such as Richland, Albion, Iowar, and Nebraska No. 21, have yielded as well as, or better than, the parent variety. (Fig. 9.) These early maturing, short-strawed, small-kerneled oats apparently are able to produce much more satisfactory yields with limited rainfall than the larger kerneled, taller strawed midseason varieties, such as Silvermine, Swedish Select, and Victory.

In the northern section of the Great Plains area midseason varieties, such as Silvermine, Banner, Lincoln, and Victory, frequently are preferable to the early sorts. In many districts in this northern portion the Kherson strains also do well and sometimes are grown. In this northern area a choice may be made between the midseason or early varieties. If spring conditions are adverse and make seeding impossible at the most favorable time, an earlier maturing variety may be sown at a later date.

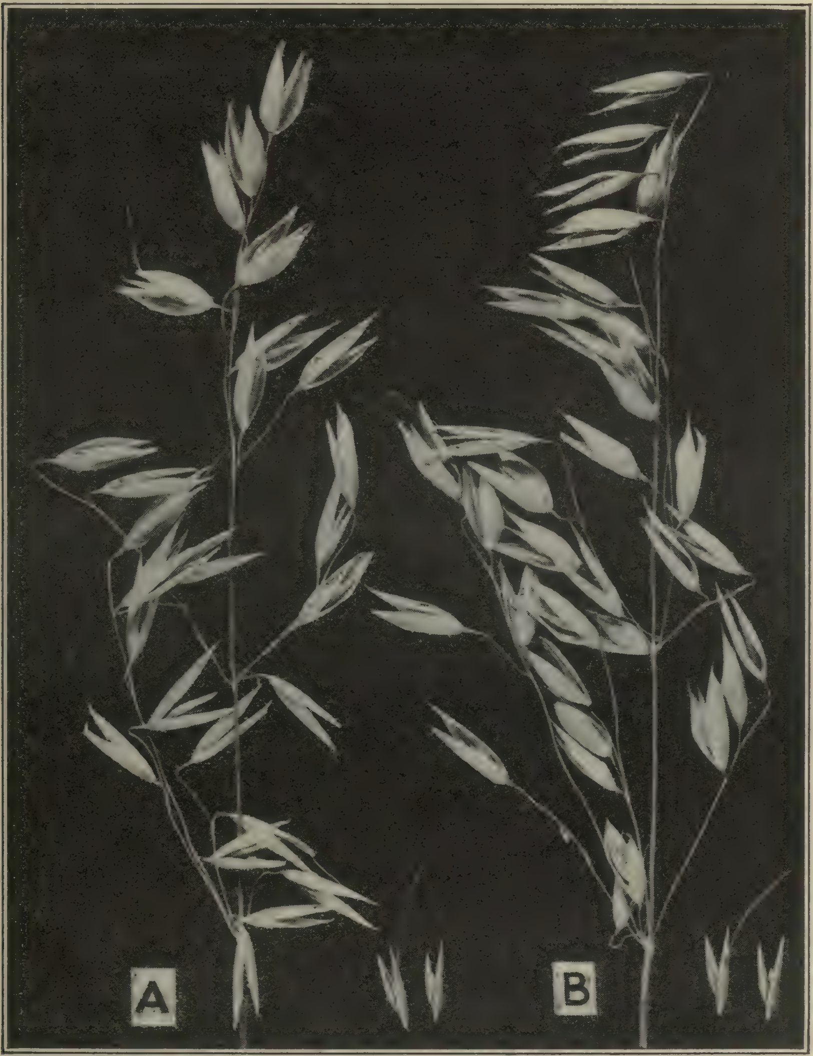

FIGURE 9.—Panicles of Kherson (A) and Richland (B) oats, early short-strawed varieties well adapted for growing in the Great Plains area

VARIETIES FOR THE ROCKY MOUNTAIN AND INTERMOUNTAIN AREA

As previously mentioned, varieties maturing in midseason are mostly grown in this area, especially under irrigation, since they can fully utilize the abundant water supply. Many early varieties have been grown in comparative experiments throughout this area, but in most seasons they have been exceeded in yield by the later and larger varieties. Only in exceptional seasons is the reverse true, that is, in seasons when water is short or hail damages the crop. Among the varieties which are grown under irrigation may be named Silvermine, Lincoln, Swedish Select, Banner, and Victory. The three most important selections or improved sorts of this group are Colorado No. 37, Idamine, and Markton.

Colorado No. 37 was developed by the Colorado Agricultural Experiment Station as a selection from the Swedish Select variety. It is not quite so tall and has fewer awns than that variety. It is rather extensively grown in Colorado and to some extent in Utah as an irrigated crop.

FIGURE 10.—A field of excellent oats of the Victory variety in Skagit County, Wash.

Idamine is a selection from a commercial strain of Silvermine, known as Funk, made at the Aberdeen (Idaho) Substation. It is a typical strain of Silvermine, but possesses a whiter kernel than most selections of that variety. Its distribution has been confined principally to southern Idaho.

Markton was developed at the Sherman County (Oreg.) Branch Experiment Station as a selection from an unnamed oat originally brought from Turkey. It is a very productive early to midseason variety, highly resistant to or immune from the smuts of oats. This new variety has become of considerable commercial importance in eastern Washington and Oregon, northern Idaho, and adjacent Montana. Its place as an irrigated oat remains to be determined, however.

The White Tartar (White Russian), a late side oat, frequently is grown under irrigation. This variety is decidedly inferior to most of the midseason varieties previously mentioned. Golden Rain, a yellow-seeded, very tall, midseason oat, has been one of the most productive varieties grown under irrigation. Where oats are grown primarily for feed on the irrigated farm the yellow kernels of Golden Rain are not objectionable.

VARIETIES FOR THE PACIFIC AREA

VARIETIES FOR WESTERN OREGON AND WASHINGTON

For spring seeding in Oregon and Washington midseason varieties, such as Abundance, Swedish Select, Silvermine, Banner, Markton, and Victory, are grown for the most part. Of these, Abundance, Banner, and Victory probably are most extensively grown. The cool climate and rather generally favorable conditions have made these slightly later maturing sorts the most productive. A field of Victory oats in western Washington is shown in Figure 10. In recent years the Markton variety has come into commercial production. It is attracting interest because of its high-yielding ability and its freedom from the smuts of oats.

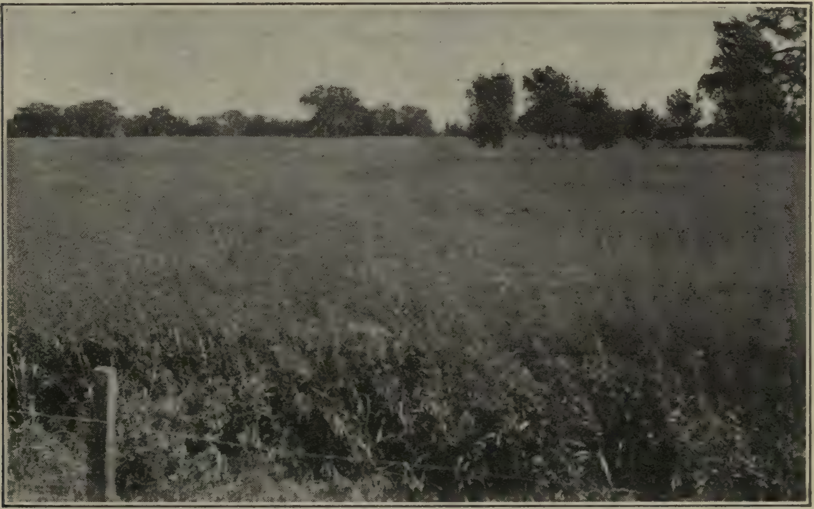

FIGURE 11.—A field of Fulghum oats about ready for harvest near Davis, Calif.

Such late side-oat varieties as White Tartar and Sparrowbill are grown to some extent in a few sections. The inherent lower yielding power of these varieties makes them less satisfactory than the midseason sorts previously mentioned.

As in the Rocky Mountain and intermountain area, early oats are not sufficiently productive in western Oregon and Washington to be recommended.

For fall seeding in the Willamette Valley the Winter Turf (Oregon Gray Winter) is chiefly grown. This variety is identical with the Winter Turf oat grown in the northern portion of the winter-oat belt of the Southeastern States. It is the most typical winter variety known in the United States. The plant grows rather tall and has narrow dark-brown leaves. Under the favorable climatic conditions in western Oregon this variety ordinarily produces an excellent quality of grain. Although the kernels are gray, they are clean and bright.

VARIETIES FOR CALIFORNIA

Oat culture in California is limited almost entirely to the varieties of the red-oat group (*Avena byzantina*). White or northern oats are poorly adapted and can not be recommended, except possibly in northern California. The adaptation of the so-called warm-climate varieties, such as Red Rustproof, Fulghum, and Burt, has made oat production possible in California.

The Red Rustproof (California Red) variety has been standard in California for years. It is the most extensively cultivated and widely adapted oat in the State. In recent years Fulghum and Kanota have become popular. Varietal experiments conducted at University Farm, Davis, Calif., indicate that the Fulghum strains (including Kanota) are superior to those of the California Red. The earliness of Fulghum apparently enables the crop to escape some heat and drought damage. Results so far obtained from the Fulghum oat on farms and in experimental plots indicate that the variety should be strongly recommended for that State. A field of Fulghum oats in California is shown in Figure 11.

In the north-central coast district of California the Coastblack variety also is grown. This black oat has a very long growing period. It belongs, however, to the so-called red-oat group (*Avena byzantina*). In all kernel characters other than color it is similar to the Red Rustproof (California Red). It is distinct, however, in its adaptation. It is taller and of later maturity and produces grain of poorer quality. Both the Red Rustproof (California Red) and Coastblack are grown rather extensively in California for hay.

OATS FOR HAY

A considerable acreage of oats is cut for hay in the western half of the United States, especially in the Pacific area, where they produce heavy hay yields. Because of seasonal developments of weather or markets, oats sown for seed purposes often are harvested for hay. When sown especially for hay purposes oats frequently are grown in combination with peas, common vetch, or Hungarian vetch. Oats intended for hay should be cut in the soft-dough stage. When cut at this stage and properly cured, oats make a very palatable and highly nutritious hay which is relished by all classes of livestock. The addition of peas or vetch usually increases the yield of hay and improves its quality.

Cultural methods for growing oat hay are similar to those described for grain production. When sown in combination with peas, a common proportion is 5 to 6 pecks of oats and 4 to 6 pecks of peas, sowing the mixture at the rate of 10 to 12 pecks to the acre. For the oats-vetch mixture the proportion is 6 to 8 pecks of oats and 60 pounds of common vetch or Hungarian vetch.

Hay from oats alone or from oats grown in combination with other crops is cut and cured similarly to other hay. Curing in the windrow or cock is a common practice.

The varieties of oats commonly grown for grain in most sections, as a rule, are the most satisfactory for hay. In sections where both the short-strawed early and the taller midseason varieties are grown, the latter usually are preferable because of the heavier yield of forage or straw.

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ROPAGATION OF AQUATIC GAME BIRDS[1]

y W. L. McAtee, *Senior Biologist, in Charge, Division of Food Habits Research*
Bureau of Biological Survey

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INTRODUCTION

AQUATIC GAME BIRDS, exclusive of the shore and marsh species, which have not yet proved adapted to artificial propa-ation, include in the United States only the family Anatidae, or lucks, geese, and swans. Of these birds, the wood duck and swans re now the beneficiaries of extended close seasons, so that they are ot on the game-bird list. As these may be propagated in captivity, owever, and are kept for ornamental purposes, directions for their are are given in this bulletin.

A surprisingly large number (nearly 50 species) of the ducks, eese, and swans of North America have been bred in captivity, most f them, however, upon only a small scale. About 20 species have been red rather frequently either in this country or abroad, and at least ne of them, the common mallard duck, can be propagated as readily s, if not more readily than, the ring-necked pheasant of the group of pland game birds. The directions for propagating here given pply primarily to the mallard and the Canada goose, the most requently reared birds of their groups. These directions summarize he experience of the most successful breeders both in the United States and in Europe. Exceptional treatment found desirable in he care of other species is noted.

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[1] The following publications may be had free by applying to the United States Depart-ent of Agriculture, Washington, D. C.: McAtee, W. L. PROPAGATION OF UPLAND GAME IRDS. U. S. Dept. Agr. Farmers' Bul. 1613; PUBLICATIONS OF INTEREST TO GAME BREED-RS. U. S. Dept. Agr., Bur. Biol. Survey Leaflet Bi-203 [Mimeographed]; DEALERS IN AME AND ORNAMENTAL BIRDS. U. S. Dept. Agr., Bur. Biol. Survey Leaflet Bi-458 [Mimeo-raphed].

GENERAL CONSIDERATIONS

LICENSES

Most States have laws or regulations affecting the propagation of game birds, and many require game breeders to take out licenses. In addition, Federal permits are necessary for lawful possession of wild ducks, wild geese, swans, and other migratory game birds in captivity. Federal permits are obtainable through the Bureau of Biological Survey, United States Department of Agriculture, Washington, D. C., as are also copies of digests of State laws on game-bird propagation, and the addresses of officials to whom application should be made for State licenses and for the full text of State laws relating to the propagation of game birds.

SITE

POND

The usual basis of an establishment for rearing aquatic game birds is a shallow lake or pond (see illustration on title-page), preferably of not more than a few acres in extent and fed by running water. A considerable part, if not all, of the shore line should slope very gradually, so as to give the birds an approach to the water that will not require jumping or falling in.

Natural marshy growth for nesting cover about the margin of the pond is desirable, but other vegetation can be substituted for it artificially, as noted under directions for planting, page 20. If natural shelter against cold winds is lacking, either a high bank should be built on the proper side or dense shrubbery, preferably evergreen, should be planted, or both. To prevent escape of breeding stock and to keep out natural enemies, it is advisable to inclose the pond and all adjoining land to be used with woven-wire fence. Types of fencing are discussed on pages 6–8. The fence should be at a fair distance from the water at all points and should be screened with shrubbery or vines to prevent the birds from being disturbed by outside occurrences. There is a happy medium to be observed in locating the fence, however, for the larger the area inclosed the more difficult will be the task of finding nests and the greater the probability that some of them will entirely escape detection.

The usual duck pond is made by damming a small stream. A massive clay or clay-and-gravel dam holds small bodies of water satisfactorily, and such a dam, as well as an efficient water gate for it, can be homemade.[2] Local experience may be taken as a guide as to whether the soil is suitable for earthen reservoirs. Ground underlaid by porous limestone and loose soils in general are unsuitable. Under such conditions concrete basins should be made, shallow, well sloped toward the outlet, and designed in every way for easy draining and cleaning. For earthen dams a mixture of 1 part of clayey material to 2 or 3 parts of gritty material is best, combining weight, stability, and water-tightness. The dam should be three or four times as broad at the bottom as at the top; it should be level at the top and considerably wider when newly built than will be necessary later, as it will wash away to some extent. The outer side may be protected by turf and the inner by stones when practicable. The spillway for the water gate may be a concrete channel of appropriate dimensions, in the walls of which tapering slots are molded (Fig. 1.)[3] The beveled ends of 1-inch flashboards, or heavier planks if necessary, fit in these, and between them clay is tamped. It is easy to raise or lower the level of the pond by adding or removing boards, or the whole gate may be pried up from the bottom to give an outlet.

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[2] Full instructions for building dams are given in the following publications: FORTIER, S. FARM RESERVOIRS. U. S. Dept. Agr. Farmers' Bul. 828, 36 p., illus. 1917; and TALBOT, M. W. RANGE WATERING PLACES IN THE SOUTHWEST. U. S. Dept. Agr. Bul. 1358, 44 p., illus. 1926.

Muskrats may become a pest by burrowing in earthen dams, but they do not burrow where the water level is always kept within about 6 inches of the top of the dam, so that there is no room for an air chamber that the water can not enter.

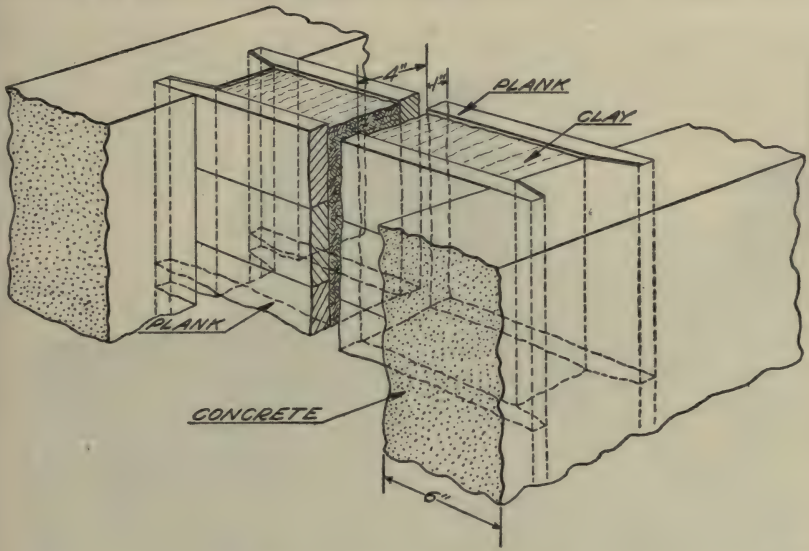

FIGURE 1.—Detail of water gate

In laying out a small pond, care should be taken to provide a bottom that slopes evenly from all parts toward the outlet, so that it may be drained and cleaned from time to time when the condition of the water seems to indicate the necessity.

Two hundred breeding mallards have been satisfactorily handled in a 3-acre inclosure containing a pond of only 250 square feet. One authority advises 18 square feet of water for each duck, and another thinks that for mixed species of waterfowl it is best to provide about 50 square yards of water for each breeding pair.

REARING FIELD

Besides a pond a rearing field will be needed for the proper care of young birds. (Fig. 10.) In small-scale operations, a spacious lawn or grassy orchard may be made to serve, but when many waterfowl are to be reared, especially as a yearly program, more extensive accommodations must be prepared. The satisfactory rearing field should be on a sunny exposure, but with plenty of either natural or artificial provision for shade. The area should be moderately sloping or otherwise well drained and should be rather smoothly cultivated so as to give many more or less level spots for coops. The prime requirement in a rearing field is to have it covered, at the time needed, with a rich growth of mixed clover and grasses, which will supply not only ample green food for the young birds but also a plentiful supply of the small insects that breed upon such luxuriant and succulent vegetation. It is well to change from one rearing field to another from year to year, the vacant sites being renovated by plowing, fallowing, fertilizing, and rotating of crops. Spare rearing fields for emergency use, as in case of an outbreak of disease, also are highly advisable, so that for continuing operations about four times as much land should be available as is required to care for the birds properly for a single year.

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[3] Of the illustrations in this bulletin, Figure 11 was contributed by the Kentucky Game and Fish Commission; Figures 13 to 15 by M. D. Phillips, and Figure 16 by the New York Conservation Commission.

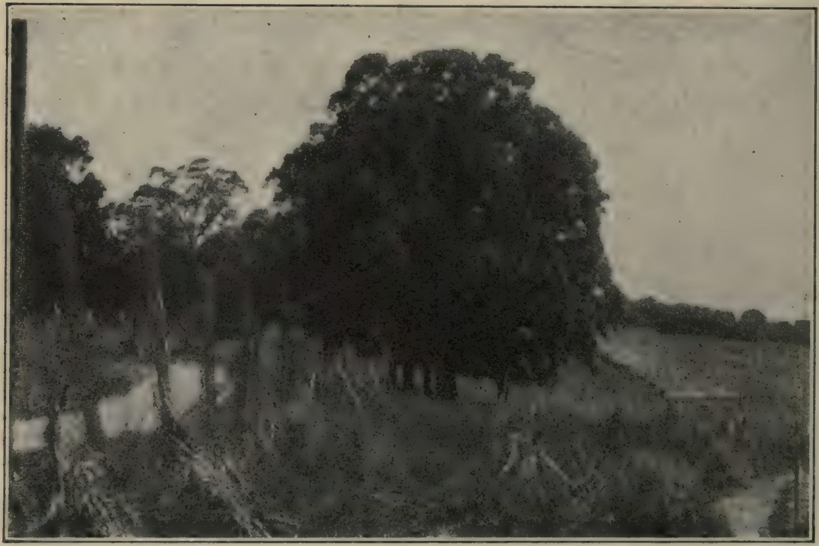

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FIGURE 2.—Cornstalk and brush shelters for duck nests

NESTING SITES

Tussocks and old logs and stumps in swamps, and litter from previous years' vegetation in marshes, furnish the usual nesting sites for most wild ducks. The nesting place is well screened as a rule by the growth of the year. Ducks in inclosures take to a variety of cover, and where there is not sufficient growing cover, shelters made of corn fodder or branches of evergreens (fig. 2) can be substituted. If, as is usual, the duck eggs are to be gathered for incubation under hens or otherwise, the area available to captive birds for nesting sites must be kept down to a reasonable minimum, or the difficulties of finding and regularly inspecting nests will become too great. Restriction of the area available to ducks for nesting is easily accomplished in parked surroundings by keeping the grass closely mowed except in small patches, preferably about shrubbery.

Islands are attractive as nesting sites, especially to deep-water ducks, but sometimes because of difficulty or neglect in inspecting them, they become harbors for vermin.

Wood ducks and a few other species that naturally nest in holes in trees will use nest boxes. These may be placed on trees or on posts within a few feet of the ground or water, along shore or on islands. Each should have an inside space measuring about a foot in each direction, with an opening 4 by 4½ inches in one side near the top. The roof should be sloped, projected well beyond the sides, and hinged to permit access to the interior. A cleated walk or slab with bark on it should be provided, leading to the entrance by an easy grade.

Sometimes species of ducks that do not naturally nest in holes will use nest boxes of the type described, and various species will lay in a simple box shelter on the ground. These may be from 1½ to 3 feet square and from 1 to 1½ feet high, without bottom, and may have one side half open for an entrance. Laid upon the ground and partially hidden by shrubs or herbs, they often prove attractive.

SANITATION

Birds are unable to tell of their discomfort, and often no difference in appearance or behavior can be noted before one is sick unto death. Treatment then is generally ineffectual. From every point of view the watchword should be "prevention." One cardinal rule for the game farm is to keep the living quarters of the indispensable poultry always entirely separated from those of the game birds. Domestic fowls have diseases to which they are more or less resistant but which may carry off captive game birds like a plague. It is well even for the sake of the poultry to change their quarters occasionally and to renovate the land; but under no circumstances should ground fouled by poultry be used for game birds until it has been baked by the summer sun, frozen by the winter cold, and plowed, fallowed, planted, and renovated to the last degree of thoroughness.

The prevention of disease depends to a great extent also on the policy followed in respect to the introduction of new stock on the game farm. On a going farm it pays to let well enough alone. The acquisition of fresh stock is fraught with such danger that it should not be undertaken except when the need is unmistakable. The fertile, well-managed game farm will have vigorous healthy stock, and once having it, a reasonable degree of selection being exercised, the owner need give no consideration to the bugaboo of inbreeding. When for some important reason it has been decided to bring in new birds, they should be held for observation for some time before they are allowed to mix with regular stock. For this quarantining, roomy and sanitary inclosures should be provided, since crowded quarters in themselves tend to promote disease.

The following precautions against disease may be specially suggested for aquatic game birds:

Never place the young where there is not plenty of shade. Adults also need shade, but they are not so susceptible to harm from the sun's rays as are the young.

Do not overcrowd.

See to it that young and old always have a perfectly dry place both for sleeping and for retreat in the daytime.

Remove all food not eaten by young birds and do not expose their drinking water to the sun.

Segregate sick birds at once and burn the bodies of all birds that die of disease. Spade and quicklime the pen in which they have been confined.

CONTROL OF ENEMIES

After disease, feathered and furred flesh eaters, popularly called "vermin," are the worst obstacles to success that the game farmer has to overcome. Among birds, the great horned owl is probably the most destructive where aquatic game birds are being reared. Sometimes some of the larger hawks are tempted by the plentiful supply of food offered by a well-stocked game farm, but as these hawks are habitual mousers, warfare against them should be upon individual offenders and not upon the race. The smaller bird hawks, and owls other than the great horned, may take some young birds when opportunity affords, but crows are the worst flying enemies of both ducklings and eggs. Night herons occasionally prove troublesome.

Among mammals the most dangerous foes of birds on game farms are cats, free-roving dogs, rats, and weasels; of lesser importance are minks, foxes, badgers, skunks, opossums, and raccoons. Snakes sometimes figure prominently as egg thieves; and bullfrogs, snapping turtles, and such fish as pike, pickerel, and bass, if allowed to live in a duck pond, will seize and devour a great many ducklings and even attack adult birds.

These various animal pests find a center of attraction in game farms, and the necessity for their control in such places is freely admitted. Efforts along this line, however, are apt to vary widely. Some are well considered, selective, just, and sensible; others are blundering, indiscriminate, unnecessarily cruel, and fanatical.

FENCING

Usually the main dependence for predator control is appropriate fencing. The entire farm may be surrounded by a permanent vermin-proof fence; or the rearing or breeding fields may be guarded either by semipermanent fences, or even by temporary and easily movable fences that will exclude most natural enemies; or all such fencing may be dispensed with and only the bird pens themselves used to give protection. The pens are usually built so as to keep out both ground and winged enemies.

PERMANENT FENCE

Fencing of a type deserving to be called permanent is expensive—prohibitively so in most cases where profits are an object. Suggestions, however, as to the construction of such a fence may be in some demand, and hence are given here. The permanent fence should have concrete posts and a foundation of equal thickness, the latter extending about a foot both above and below ground, and in the upper part of it the woven wire should be embedded. All mesh should be of the type galvanized after weaving. The lower course of 30 to 36 inches should be of ½-inch or ¾-inch mesh and should have extending outward from its upper margin an overhang 1 foot wide of the same mesh. The upper part of the fence should be of not more than 2-inch mesh, and the top of it should be supported by a tightly strung barbed wire. Several other closely spaced strands of barbed wire or another overhang should form the top of the fence. The total height, excluding overhang, should be at least 8 feet. Modifications that may be made in this fence that will not seriously affect its permanency are the use of creosoted poles for all but corner and gate posts, and creosoted cypress (pecky for economy) planks, 1 by 6 inches, instead of the concrete base.

SEMIPERMANENT FENCE

The ordinary semipermanent fence (fig. 3), generally used where the degree of protection it affords is sufficient, departs from the ideal in several respects. However, wire galvanized after weaving is preferably used. The posts are all wood, creosoted at the base if possible; the mesh of the lower course is 1 inch, and about 6 inches of this width is buried in the ground. The overhang if placed at the top of this strip is of the same mesh, for it is wasteful to use for an overhang mesh smaller than that which it surmounts, because small climbing vermin will go through the first openings they find large enough.

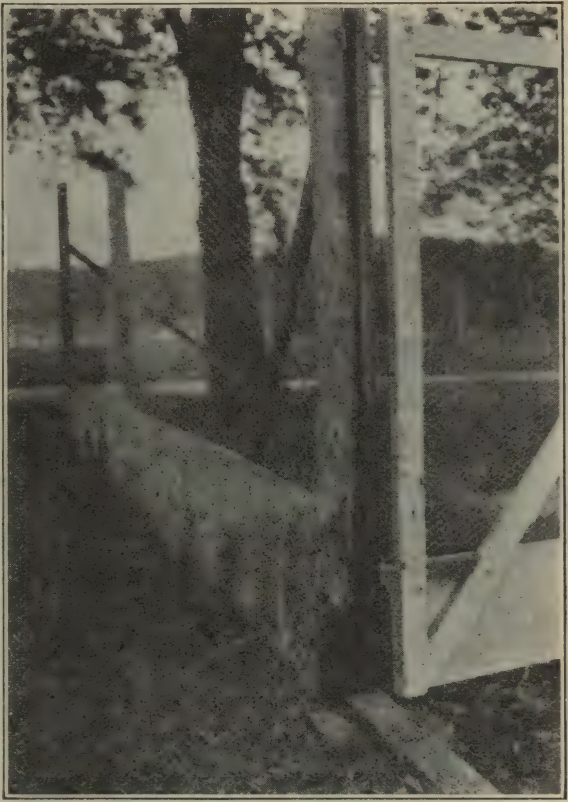
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FIGURE 3.—Semipermanent vermin-repelling fence

The upper course of the ordinary fence is of the familiar poultry netting (2-inch mesh), and the overhang (1 to 3 feet wide) at the top is of the same material. The height should be 8 feet but sometimes is only 7. It is well to have a supporting strand of barbed wire along the top to keep the fence in better shape and especially to resist the weight put on the netting by sleet storms. It may be necessary also to reinforce a netting fence with barbed wire strung where horses, cattle, or hogs may come in contact with it.

TEMPORARY FENCE

Where the vermin problem is not serious or where general activity against predators keeps them under such control as not to involve too great risks, temporary or portable fencing is used to advantage. The supports for such fences are light poles put in holes made with a crowbar. The lower course (3 feet) of the fence is of 1-inch mesh (sometimes closer when it can be afforded) that has a single furrow turned over its base. The upper part (6 feet) is poultry wire without overhang. The two strips of mesh are pinned together with nails. This fence can be quickly and easily moved from one field to another and, on account of the frequent rolling and general wear and tear that it undergoes, for economy it is usually made of wire galvanized before weaving.

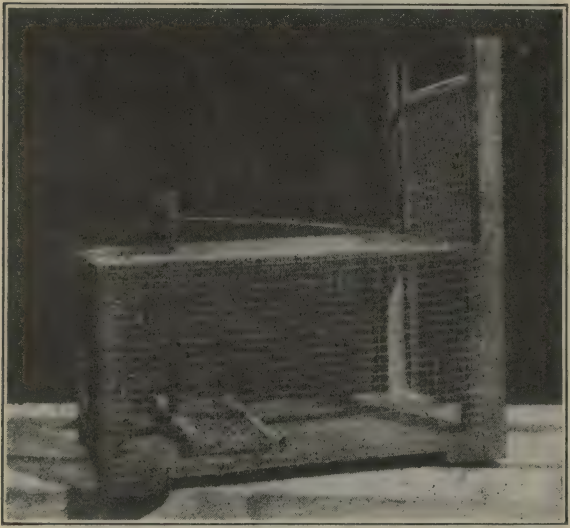
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FIGURE 4.—Evans vermin trap. This trap is 14 inches high, 17 inches wide, and 24 inches long. The front standards are 27 inches tall and contain a slot three-eighths of an inch wide and five-eighths of an inch deep. The door measures 15 by 12 inches. Door and treadle (6 inches wide) have the edges soldered in folded strips of heavy zinc. Mesh is five-eighths of an inch square, heavily galvanized. All screws are brass, the spring phosphor-bronze, and the levers iron. The corner posts are tinned inside and the whole trap dipped in paint. The small triangle of tin on the far standard falls across the slot when the door is down and prevents it from being raised

TRAPPING[4]

Theoretically, a vermin-proof fence should make trapping unnecessary. Unfortunately such fences rarely are entirely proof against natural enemies, and, if so at first, seldom retain perfect effectiveness. Predators having once entered the game farm or subsidiary inclosure, it is necessary to combat them directly, and trapping is a favorite method. Traps are indispensable aids in controlling vermin, but their use is often turned to abuse. Care should be taken as to where and when they are set, and as to how long they remain set. A set trap is dangerous 24 hours a day every day, and will catch other creatures just as effectively as those particularly sought. It should not be placed, therefore, where it will be a menace to other than the offending animals. It should not remain set after danger has passed. While set it should be inspected at least once daily so as to shorten the period of the captive's sufferings and to permit release of innocent creatures. This last consideration makes traps that catch their victims alive and uninjured preferable to traps that kill or that cripple when they do not kill. A decided advantage of such traps is that stray game birds getting into them can be restored to stock.

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[4] The limits of this bulletin prevent giving specific instructions for trapping various kinds of animals. These may be found in general works on the subject of trapping, a list of which may be had upon application to the Bureau of Biological Survey, U. S. Department of Agriculture. State laws relating to the protection of fur-bearing animals, many of which are on the game breeders' list of vermin, are summarized in a Farmers' Bulletin that can be obtained from the U. S. Department of Agriculture.

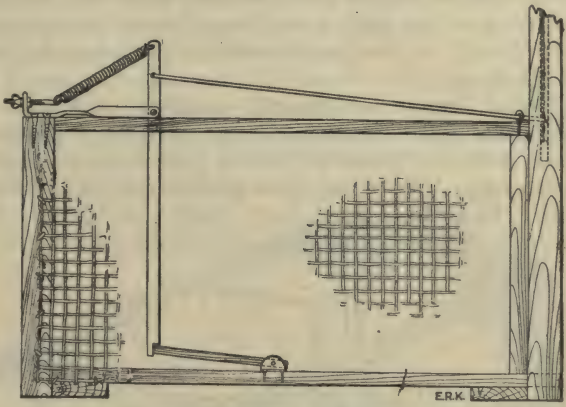

Figure 5.—Operating parts of Evans vermin trap

TRAPS FOR GROUND ENEMIES

The Evans vermin trap illustrated in Figures 4 to 6 is ideal for ground enemies, since it can be built in any desired size and captures without injuring. Probably the best way of disposing of destructive animals caught in this trap is to shoot them with a small-caliber pistol, which can be carried in a pocket without inconvenience. Harmless snakes, frogs, toads, rabbits, and other innocuous animals caught in this trap can be released alive if inspections are made daily, as they should be.

Figure 6.—Evans trap set along fence

The Evans trap is very effective when set with one side close against a fence. (Fig. 6.) Sometimes a stake is placed against the outer frame of the door to hold the trap firmly against the fence and to support a short wing of wire netting flaring off to another stake to direct into the trap animals that might otherwise pass a few feet away. Sometimes the trap is set with the mouth against an opening in the fence, and so hooded over with wire netting that entrance into the trap is the only possible course. Ordinarily no bait is required, but should its use become desirable it can be wired to the back wall of the trap.

Other traps that capture animals alive are illustrated in Figures 7 and 8. The Melbrook trap is framed with channel iron, covered with wire mesh, and provided with a door and treadle of heavy-gauge sheet iron, thus being strongly constructed and all metal, an advantage in preventing gnawing animals from getting out and in making the trap easy to clean. The Fooks trap (fig. 8), seen in Europe, is especially useful for setting along fences or in comparatively small spaces likely to be the runways of predators and is said to be most effective when covered with brush. It is a tunnellike box about 40 inches long and 8 inches square, which is always open at both ends and set except when it contains a captive. It contains two treadles each approximately half as long as the box, which are covered with sheet metal to prevent rats from gnawing out. The remainder of the inner surface also can be lined with sheet metal or wire mesh if necessary. The treadles are thin at the outer end and fit snugly against the floor in the set position. They pivot at about the middle, and an animal passing this point tips them up at the outer end, which

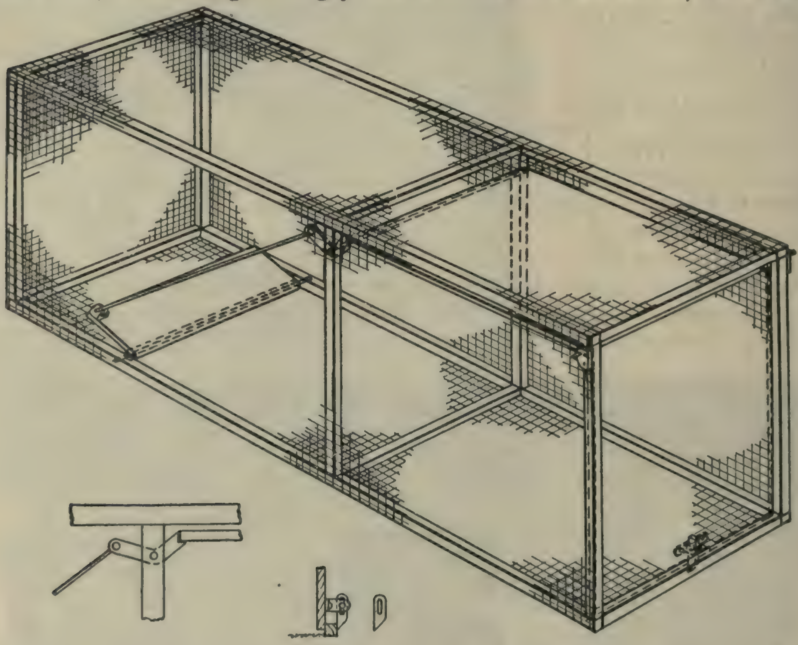

FIGURE 7.—Melbrook trap in set position; the door (under near half of top) falls when the treadle is depressed, releasing the trigger shown in separate outline drawing, and has a sliding bolt that catches on the frame and holds the door closed

remains raised because of a wire wicket slung underneath, which catches on the floor and prevents the outer end of the treadle from coming down, and which in the fully vertical position holds the treadle firmly up against the top of the entrance. The treadle occupying the other half of the trap operates instantly as the captive passes the middle. A door on the top at the middle gives opportunity for inspection through the netting roof or lining.

In certain cases it is necessary to vary the method of trapping, and then ordinary steel traps can be used. These are probably the best devices for use against rats[5] under buildings and other structures. Great care must be taken, however, to set these traps where game birds can not get into them. In burrows under objects and in holes where the birds can not go the trap may be set without special protection. Elsewhere it may be put under a box with a notch cut in the edge, under a troughlike shelter made of three boards, or under a cover improvised from wire netting, in each case, however, with the entrance to the trap so small that the birds can not get in. All such sets are best made along fences where ground vermin are prone to run. Ground traps of all kinds should be kept out of rearing fields where there are small game birds.

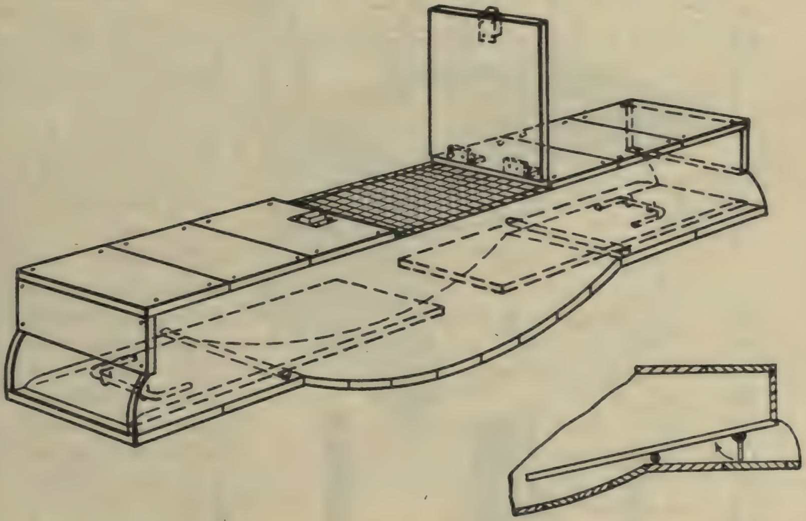

FIGURE 8.—Fooks trap. The middle section of the bottom need not be round, but can be broadly V-shaped

TRAPS FOR BIRDS OF PREY

Winged enemies also have been combated chiefly by use of traps. The most common device is an ordinary steel or jump trap set on the flat top of a post or pole and fastened to it by the chain of the trap. These traps instantly kill small birds getting into them and usually are the cause of lingering death to larger species, which in their struggles fall with the trap from the top of the pole and hang head down until death ensues. Birds that do retain their perch on the top of the pole usually have one or both legs injured so that it is necessary to kill them. These troubles can be obviated in part by having the chain of the trap attached to a large ring around the pole or a smaller one on a wire that will slide to the ground when the trap is moved from the top. This permits the release alive of any useful bird that has not been crippled by the first grip of the trap.

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[5] Full information on the control of rats is contained in the following publication: SILVER, J. RAT CONTROL. U. S. Dept. Agr. Farmers' Bul. 1533, 21 p., illus. 1927.

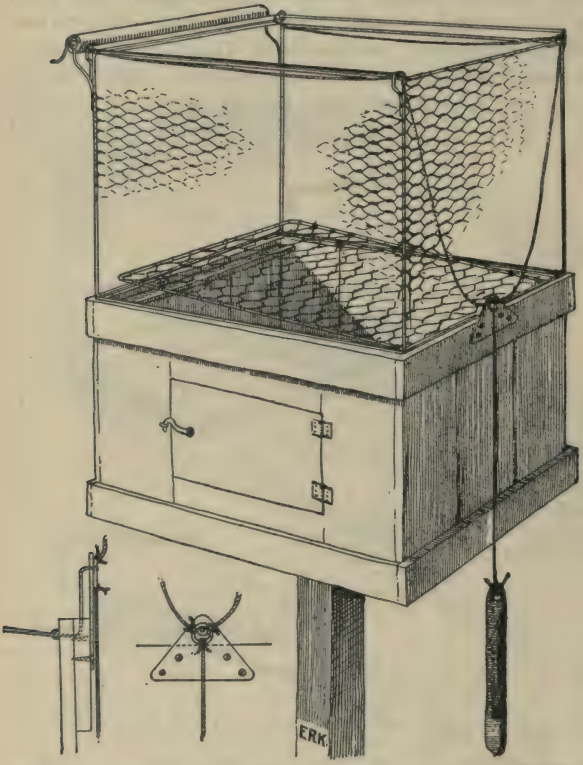

FIGURE 9.—Basket trap for hawks. A live chicken or pigeon is kept in the lower part of the trap for bait. A hawk endeavoring to strike the fowl depresses the wire netting floor of the upper part of the trap, releasing the weight, which pulls over the top of the trap the rolled curtain shown at the left

As ordinarily used pole traps are objectionable in several respects. Not only should the number be reduced to the minimum but also the objectionable features of those kept in use should be lessened. Breaking the legs of larger birds can be prevented by wrapping the jaws of the trap near the ends with hard cord of sufficient diameter to keep the jaws well apart when sprung. This will hold the larger birds but will permit the escape of such smaller ones as are not disabled or killed when struck by the jaws of the trap.

The indiscriminate killing of various small birds is the greatest fault of pole traps. If the traps are kept set at all times, a number of small birds will be killed to every hawk captured. It is a painful experience to make the rounds of a game farm and find flickers, red-headed woodpeckers, kingbirds, and bluebirds dead in the pole traps. Such destruction of innocent birds not only constitutes unnecessary cruelty but is also wasteful of these useful birds' lives and in most cases is a violation of Federal or State law. The killing of small birds by pole traps can be obviated, in part, by setting traps too heavy for such birds to spring them. Another device is to put a pad of cotton under the pan that will compress under the weight of a larger but not under that of a smaller bird. Both legal and humanitarian considerations require that the use of pole traps be carefully regulated. If moderation in using them is not observed, legislation entirely forbidding their use may be expected.[6]

Devices that make it possible greatly to reduce the number of pole traps and at the same time to retain the effectiveness of those used against predatory birds are (1) tapering the tops of most of the fence posts to a point, and (2) guarding flat-topped posts by inserting in each an erect, slender wire to prevent large birds from perching upon them. If all the ordinary fence posts are so treated and only selected posts or poles provided with traps, the large birds will be driven to the latter when they seek to alight. Some hawks habitually perch to watch for prey, and while these are the species least destructive to birds, they are the very ones that are most frequently caught in pole traps. The bold, dashing bird hawks are more apt to come skimming over the tops of fences and pounce without a pause upon the first victim that offers.

Because of their selective destruction of the less harmful hawks, and of their danger to bird life in general, pole traps should be abolished as rapidly as practicable. Traps that capture birds alive should be substituted for them, so that harmless species can be released. Suggestions for such a trap are given in Figure 9. A cage with live hawks or owls in it attracts other birds of these kinds, and may be placed near a pole or basket trap to decoy such visitors to the farm.

SHOOTING AND OTHER METHODS

The patrolling of the game farm by an armed man with a well-trained dog is probably as satisfactory a method for the control of diurnal enemies as can be had. This conclusion rests on the supposition, however, that the man knows his business and does not blaze away at everything alive on the place except the game birds. The man can be and should be selective in his war on enemies. His presence, together with an occasional shot from his gun, should have a strongly deterrent effect on the visits of winged predators, and his watchfulness and activity should strictly limit depredations by ground enemies. More crows and hawks can be killed by using an owl decoy and by shooting from a blind or cover than by other methods.

Where patrolling is carried on, scarecrows (fig. 10) may have some value. When manlike figures are always stationary, birds become accustomed to them, but when there is also some patrol work, with moving about and shooting, the warning effect of the stationary figures is much greater.

The Clove Valley (N. Y.) Rod and Gun Club has found that it pays to keep a good stock of cottontail rabbits as a first line of defense against enemies on areas stocked with game birds. Foxes, weasels, and certain other predators seem to prefer the rabbits or find them easier to catch; accordingly rabbits are imported into the preserve every year.

CONTROL OF CROWS

Crows are combated by poisoning or shooting. An egg into which powdered strychnine has been stirred through a small hole, afterwards pasted over with paper, is put near a nest that crows have found, provided always that this bait is out of the reach of children or domestic animals that might eat it. Another device is to put out a false nest with a few hen eggs and surround it with several steel traps concealed in loose litter. With a blind and crow call, and especially with a decoy owl in addition, crows can be lured within gunshot, and sometimes many of them disposed of in a short while.[7]

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[6] They are now outlawed in New Jersey.

CONTROL OF SNAPPING TURTLES

It is best to eradicate snapping turtles from a body of water before using it for rearing wild fowl. Seining with a net having a well-weighted lower edge is the best method of removing the turtles wholesale and is most effective in the spring before vegetation has become so dense as to interfere with dragging the seine. So far as possible snags and other obstacles should be removed beforehand.

In a large pond where seining may be impracticable, or in special cases, other means of dealing with snapping turtles may be needed. As these animals take bait readily, set lines kept in constant operation will help to reduce their number. Each set line may be prepared as follows: Anchor with weight and line a well-stoppered empty bottle that will make an easily observed float. To the bottle attach a large fishhook on a wire of sufficient length to keep the bait out of reach of the waterfowl and bait the hook with tough meat. By keeping a number of such set lines working and inspecting them regularly the number of turtles can be greatly reduced.

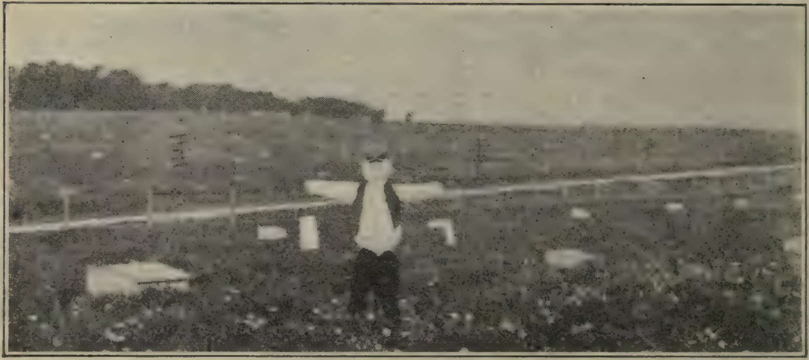

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FIGURE 10.—Scarecrow in rearing field. The inner support is a crosslike frame. An outer stake is inserted in head. Bright sheets of tin, so arranged as to turn with every breeze, are suspended from ends of arms

An effective turtle trap may be constructed as follows: Place a slab or plank 6 or more inches wide and several feet long in water frequented by the turtles, preferably near shore, so that the lower end touches the bottom and the upper extends 1 or 2 feet above the surface, providing a gradual slope up which the turtles may crawl for sunning themselves. A pound net should be built under the exposed upper end, the walls projecting above the surface of the water and made of such material and construction that the turtles can not escape from it. When suddenly alarmed, turtles on the plank will drop off into the pound where they can be captured with a dip net. Another form of turtle trap is illustrated in Figure 11.

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[7] Further information on means of controlling crows may be found in the following: KALMBACH, E. R. THE CROW IN ITS RELATION TO AGRICULTURE. U. S. Dept. Agr. Farmers' Bul. 1102, 20 p., illus. 1920.

SHIPPING AQUATIC GAME BIRDS

Ducks, geese, and swans are constituted sufficiently different from typical upland game birds to make it desirable that the containers for shipping them differ in important particulars. As these birds do not jump against the top of a crate, a fender is not needed. It will do no harm, however, to have the top lined with burlap, and a crate with only burlap for a top has been used successfully. Aquatic game birds make much more use of water than do the upland species, and this need must be provided for. The feces of these birds are copious and moist, and objectionable fouling of containers is sure to occur unless it is guarded against.

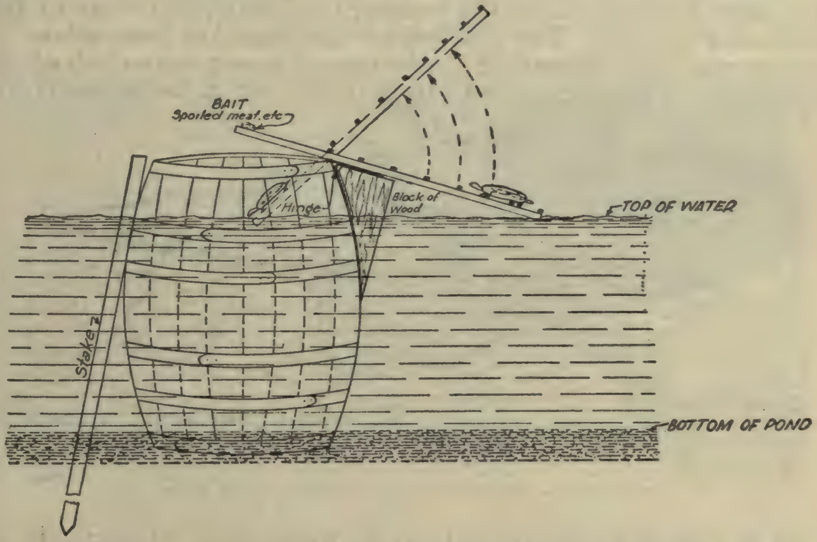

FIGURE 11.—Turtle trap. The board should be attached to the barrel by a free-working strap hinge, and almost on a balance. Cleats on the tilting board make the trap more effective

A basket or hamper may be used for shipping a few individuals of some of the smaller aquatic game birds for short distances. The climax or market-basket type, of which large and strongly built models can be had, is convenient. Such a container is light, and the prominent upstanding handle reduces the chances of its being thrown about and also prevents piling other objects on top of it. The basket can have holes to admit air and light, but these should be so small that the birds can not possibly stick their heads through them. The top should be close-fitting and firmly fastened.

Mallards, the most commonly propagated aquatic game birds, have been shipped in ordinary poultry crates, but with the added protection of a burlap lining and straw bedding. In general, propagated birds are too valuable to take undue chances on during shipment, and it will pay to construct for them well-adapted and substantial shipping containers. Correct shipping methods are especially necessary for aquatic game birds, as their general tendency to delay breeding after any change in environment may be made worse by terrifying experiences in transit.

A type of shipping container successfully used by a game farm that has shipped aquatic game birds to practically all parts of the world is illustrated in Figure 12. This crate made on the same pattern for all birds, but varying in size for the different species, is made of ½-inch lumber; the front is covered with ½-inch-mesh wire netting, and the top with strong burlap. Numerous quarter-inch holes are bored in the ends for ventilation, and in the bottom for drainage. Drainage is further facilitated by placing four cleats of ¾-inch material across the bottom, thus holding it clear of the supporting surface. The problem of drainage has been solved in another way also, by making the bottom of strong wire cloth of ¼-inch mesh. Two zinc trays (6 by 8 inches and 2 inches deep) are fitted to slide in guides from the front where each is fastened in by three door buttons. These are used for food and water, and the edges of the water tray are turned over a quarter of an inch inside to check spilling. In an extemporized shipping box for short transport a spittoon wired into the corner makes a good nonslopping water container, and an ordinary poultry food hopper firmly fastened in, and charged with enough food and grit for the trip, will take care of the birds' needs in these respects.

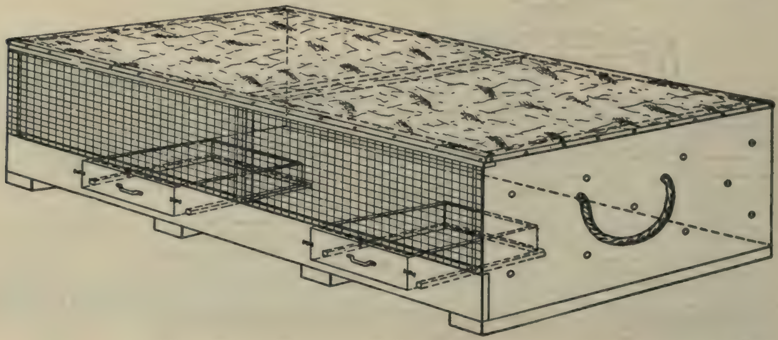

FIGURE 12.—Crate for shipping aquatic game birds

Sizes of the crate described as suitable for small, medium, and large birds are as follows: (1) 30 inches long, 18 inches wide, and 10 inches high; (2) 36 inches long, 24 inches wide, and 15 inches high; and (3) 48 inches long, 36 inches wide, and 24 inches high. Whatever sort of shipping container is adopted or improvised, a few general principles should be observed. The container should be so built that it will have a definite and easily recognized top side or even so that it can not possibly be set on that side, in order to minimize the risk of overturning. Also the top should be distinctly marked: "This side up," "Handle with care," "Do not delay," "Live birds, rush," "Keep in a cool dry place," "Please water," or with similar conspicuous signs. Light should be admitted to the container, but there should be no holes through which the birds can put their heads and no openings about the lower sides or bottom through which their feet might slip. The inside should be high enough to permit the birds to stand fully erect. The floor should be thickly covered with some form of absorbent litter (dry peat moss, straw, shavings, excelsior, or the like) and a supply sent along for renewal on long trips.

The food ordinarily given to the species concerned should be used, although for birds in transit it is better to err on the side of bulky rather than of concentrated foods. Grit is a necessary and charcoal a desirable element to include for traveling waterfowl. Oats, bran, and chopped hay are good bulky foods for geese and other large waterfowl. Small grains and green foods should be given the smaller ones. Chopped roots, vegetables, and firm fruits may be substituted for green foods. Full instructions for feeding, watering, and other care of the birds should accompany the shipment, when uninitiated persons must be depended upon for these duties. Aquatic game birds require a fresh supply of water as often as feasible, and green foods should be given to all the vegetarian species whenever available. Special foods for the largely or wholly carnivorous species will have to be provided as a rule entirely in advance.

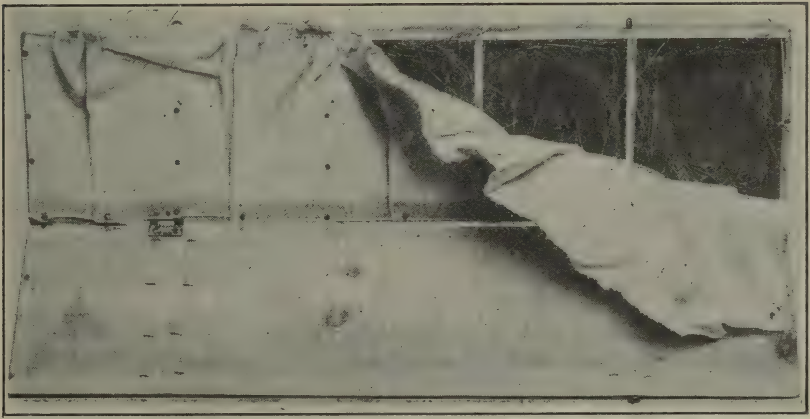

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FIGURE 13.—Shipping box for day-old ducklings. Dimensions: 28 by 7 by 4½ inches. The flannelette is tacked down and screw eyes are wired together before shipment

Large lots of birds on an extended trip, or other especially valuable shipments, should have a caretaker traveling with them. In other cases arrangements for their care can be made with transportation companies, and advance notice of shipment should be given by mail or telegraph. Different species of birds or different sizes of young should not be mixed in the same crate, as the larger birds may fight and injure the smaller. Quarrelsome individuals and geese and swans in general, except mated pairs, are best shipped singly, in separate compartments or crates.

Day-old ducklings are sometimes shipped to points that they will reach in 24 hours; the container used is like that for day-old pheasants (fig. 13), except that not nearly so much hay packing is put in each compartment.

SHIPPING EGGS AND YOUNG

Duck eggs as a rule do not travel very well. When shipped, each egg should have an individual wrapping. Some shippers wrap the eggs in two long strips of newspaper, one applied at right angles to the other; others twist them up tightly in wisps of hay. The outer packing for these individual eggs may be shavings, excelsior, hay, or similar shock-absorbing material. Mallard eggs are sometimes shipped in poultry-egg crates, but the best containers are baskets of the oblong grape-basket or the round peach-basket types. Both are light and suggest careful handling, and neither can readily be stacked with heavier objects.

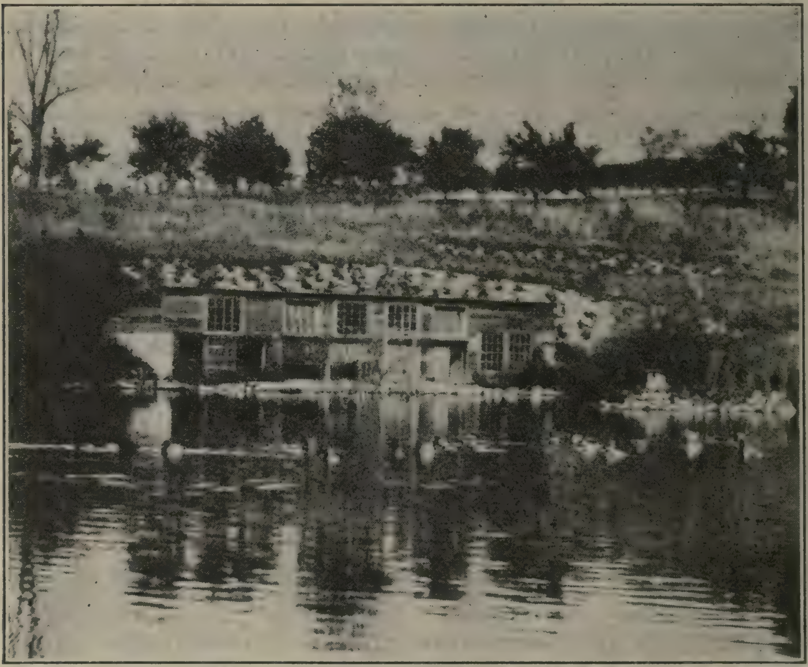

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FIGURE 14.—Wintering house for aquatic game birds

WINTER SHELTER

Shelter for the birds in severe winter weather is desirable in most places and essential in the North. Where only occasionally needed, it may consist of low, thatched hutches with abundant dry litter on the ground underneath. These should be closed on three sides to keep out snow, and the birds may be trained to use them by having feed scattered inside. Ducks usually will succeed in keeping part at least of the water available to them from freezing by their constant swimming, but where this is not easily done, it is better to provide a house of one of the types described below that inclose a pool for the birds.

In climates with moderately cold winter weather the shelter problem may be solved by building a house in the water, the under-water portion of wire cloth of mesh too small for ducks to get their heads through, and the above-water part of frame construction with plenty of south-facing windows to let in the sun. Water seldom freezes in such houses, and the ducks winter perfectly in them. It is best to have one end of these houses extend upon land, where dry quarters will be available to the birds when needed. Windows only on the south side are the rule in all duck houses, but ventilation is a necessity except in the severest weather.

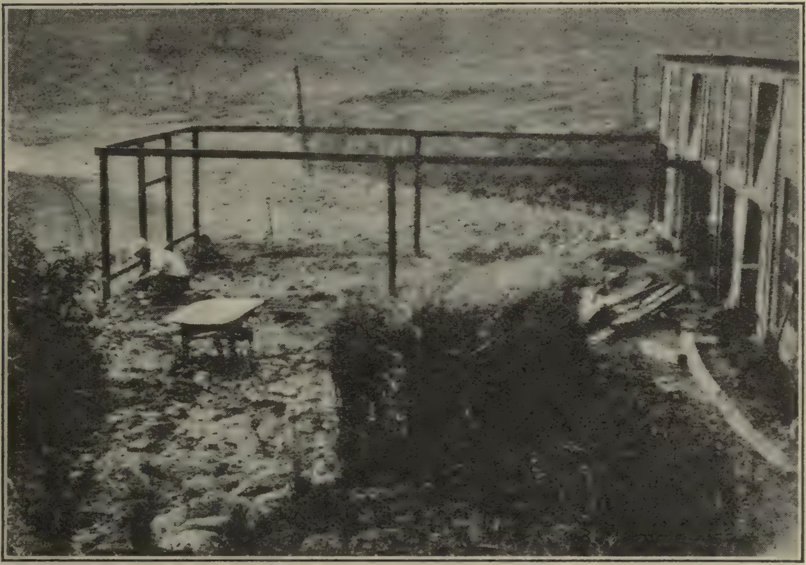
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FIGURE 15.—Wintering house for aquatic game birds. Construction of the outdoor swimming inclosure

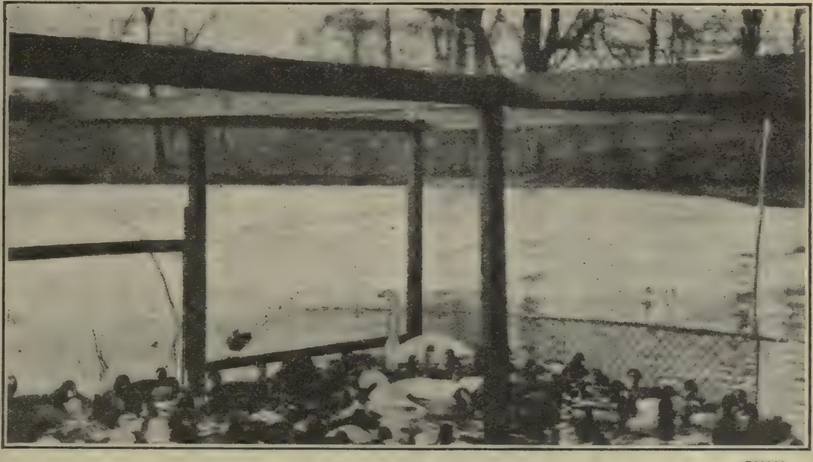
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FIGURE 16.—Wintering house for aquatic game birds. Outdoor swimming inclosure in use

The house illustrated in Figures 14 to 16 will provide adequate shelter for wild fowl in regions where real winter is the rule. It is built wholly on shore, with a netting-inclosed extension into the water at one end. The shed on shore is much on the plan of a poultry house, with the floor and lower walls of concrete. The south side consists chiefly of windows, while the others are almost solidly inclosed. There is a small window in each end, however, to aid in the thorough ventilation that has been found necessary in all but the most severe weather. The upper tier of south windows are screened with wire netting to prevent injury to birds that may dash against them while catching operations are in progress. The windows of the lower tier are each made of two hinged sections, one or both of which can be folded up and fastened for ventilation when desired. These sections contain wire netting (no glass), which is covered both outside and inside with burlap. Thus even with all windows closed there is some of the indispensable ventilation. The end of the floor adjoining the outside extension is occupied by a swimming pool fed by running water. Exit to the outer pen, the mesh sides of which are flared outwardly at the bottom and weighted with stones, is through sliding windows. The door for the use of the keeper is in front between the pool and the floored section of the house.

PLANTING

Planting is of importance in relation to the vital needs of shelter, nesting sites, and food. Fences may be covered with Japanese honeysuckle, bittersweet, or woodbine, or may be screened with hemlock or arborvitae; the latter plants are excellent also for a windbreak along shore. Marsh valuable for summer shelter and nesting sites can be made by planting cat-tails, but plants producing some duck food should be preferred, as bulrushes and other sedges, wild rice, wild millet, and other grasses. Cover for nests on shore can be furnished by any tall grasses and weeds, but low shrubs are more desirable, as broom and waxmyrtle. Trumpetcreeper and other vines sprawling over the ground also make good nesting cover.

It is impracticable to stock with food plants a pond constantly frequented by large numbers of ducks. Something can be done, however, with a lake of considerable area. For particulars as to plants adapted to various conditions and methods of propagating them, consult bulletins on wild-duck foods issued by the department.[8] These and a list of dealers in the plants may be obtained by application to the Bureau of Biological Survey.

Green food or natural roughage is very important on a duck farm, and a good way to supply it is to provide a system of unit ponds; in other words, a canal or broad ditch divided into compartments, in some of which plants can be growing under screen while the ducks are allowed to feed in the others. The best plants for such ponds are water cress, waterweed, coon tail, duckweeds, and musk grass (described in Department Bulletin 205).

BREEDING STOCK

The United States Department of Agriculture has no game birds or their eggs at its disposal, and notwithstanding press notices to the contrary never has distributed any of them. Some of the State game departments from time to time distribute certain game birds or their eggs, but the regular sources of supply are game farms and commercial dealers. Addresses of these can be obtained from the Bureau of Biological Survey, United States Department of Agriculture, Washington, D. C.

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[8] McAtee, W. L. ELEVEN IMPORTANT WILD-DUCK FOODS, U. S. Dept. Agr. Bul. 205, 26 p., illus, 1915; PROPAGATION OF WILD-DUCK FOODS, U. S. Dept. Agr. Bul. 465, 40 p., illus, 1917.

To obtain initial stock of acquatic game birds from the wild, it is necessary to have permit from the Bureau of Biological Survey for capturing the birds. (See paragraph on Licenses, p. 2.) Beginning with wild stock involves delays while the birds are becoming accustomed to restraint, which can be avoided by using propagated stock.

Breeding stock should be obtained in the fall, so that the birds may be settled in their quarters before the breeding season, which comes rather early in the spring. Even if they do not then breed, the owner should not be unduly disappointed but should remember that not all birds will breed during the first year of life or of captivity.

Birds received after a long trip should not be allowed to visit the pond, as their plumage will not be oiled and in good order and they will get water-soaked. If feathers of newly arrived ducks seem to be dirty, give the birds a pan of tepid water on a sunshiny morning; when they have again gotten their plumage in good order they may be liberated to visit the water. Feed the birds with especially nourishing food until they recover from the hardships of travel.

The production of fertile eggs is the basis of success in breeding any game bird, and difficulty in this respect has been the greatest obstacle in the case of all but a few species of wild fowl. Success with species usually slow to breed seems to depend on keeping birds, if of wild stock, long enough for them to become reconciled to their loss of freedom, and whether of wild or propagated stock, on giving the birds ample space for them to pair naturally and find suitable cover for their nests, and on allowing the necessary degree of isolation in a sufficiently natural environment. Endless patience is essential.

Hand-reared stock is a universal desideratum, and duck breeders can save one another tedious and disappointing delays by cooperating in sharing such stock.

PINIONING AND WING-CLIPPING

Stock purchased from dealers will arrive either pinioned or wing-clipped, and usually it is necessary to perform one or the other of these operations on all birds intended to be kept as breeding stock. Wing-clipping simply means shearing off the principal flight feathers, or primaries, well away from the flesh of the wing, and it is necessary to repeat the operation at least annually after the regular molt in midsummer. Pinioning means cutting off the last section (the fingers) of the wing to which the long flight feathers are attached.

To pinion an adult bird, raise the thumb of the wing (at base of last joint) and tie a cord tightly around the last joint well up under the thumb. (Fig. 17.) Have ready some tannic acid in powdered form. With a pair of strong sharp scissors or pruners, or with a knife, block, and mallet, clip off the joint close below the cord, removing all or nearly all the long flight feathers or primary quills. At once take a pinch of tannic acid and press it firmly into the wound to check bleeding. Glycerite of tannic acid (liquid tannic acid, 1 part; glycerine, 4 parts) also is used for the purpose. This seals the wound and gives good results. The cord should be removed a few days later when the wound is healing. Pinioning should never be done shortly before the breeding season. If full-winged birds must be rendered flightless at this time, merely clip the primaries of one wing.

Pinioning ducklings is very simple. Operate when the birds are 4 to 7 days old, if in good condition, snipping off the last joint with scissors and dipping the stump into tannic acid. Bear in mind that a pinioned bird never can fly; so if flight is likely to be desired at any time, it is better to continue the clipping of flight feathers.

Only one wing should be pinioned or clipped.

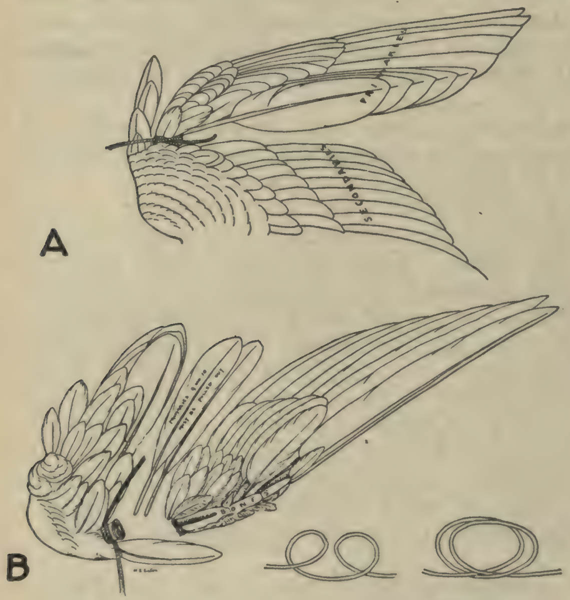

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FIGURE 17.—Method of pinioning. A, Upper side of wing showing flight feathers separated from secondaries, and tied just within point of amputation ; B, underside, showing place of amputation and form of knot used

MALLARD DUCKS

The mallard, sometimes called stock duck, because it is the source of most domesticated varieties, is reared as a wild duck also in larger numbers than any other species. The bird occurs naturally almost throughout the Northern Hemisphere, and its tolerance of a wide range of conditions no doubt is one of the principal factors in its superior adaptation to domestication. It quickly becomes accustomed to captivity and is a persistent and successful breeder. These qualities, together with the wider market for this popular species, easily give it first rank among artificially reared aquatic game birds.

REARING METHODS

The rearing methods here described may be applied on either a large or small scale, but they are of the type found suitable for quantity production. They involve proper domiciling of the breeding stock (see sections on pond, rearing field, nesting sites, etc., pp. 2–5), so as to insure maximum egg production, collection of all eggs, hatching them usually under hens, sometimes in incubators, and growing the young on rearing fields (pp. 3–4) until they are large enough to be liberated on the same general pond with the adults. This is the standard method, but mallards may also be reared " dry " exactly like pheasants. The dry system is little used, however, on account of the greater difficulty experienced in keeping the birds near the wild conformation. Mallards are prone anyway to degenerate into the barnyard type, and avoidance of overfeeding and careful selection of breeders must constantly be practiced.

FEEDING ADULTS

The first information needed by the prospective duck farmer who has the necessary ponds, shelters, and other features mentioned under " General Considerations " (pp. 2–5), and who has obtained initial stock, is on how to feed his birds.

The staple food for adult wild ducks on game farms is whole oats and mixed small grains, as wheat, barley, buckwheat, scratch feeds, and mill wastes. A mixture of weed seeds and broken rice, which can be obtained from rice mills, has been used with satisfactory results, and waste from other types of mills no doubt will serve. Little corn is fed, as a rule, and that chiefly in winter; when corn is used it should be cracked. When the weather permits, scatter the food in water, as this gives the birds their natural feeding conditions and leaves no food where it is likely to attract rats. With proper feeding, however, little or no food should be left over.

The ducks are fed twice a day, morning and evening. Forcing foods are universally used for some time before and during the breeding season; the same rich foods also are often used in winter and in special cases for birds weakened by exposure or other cause. The special rich foods are given in the form of a scalded mash, the bulk of which may consist of alfalfa meal, bran, middlings, barley meal, ground corn or oats, with a liberal addition of beef or fish scrap. Feed the mashes only crumbly moist and no more of it than the birds will consume at once. The same mixture dry, however, may be kept available to the birds throughout the breeding season, being put in a trough or hopper sheltered from rain. Good results have been obtained also by using chopped fresh fish or live minnows as a forcing food.

Roughage is desirable at all times, the best being aquatic plants, which may be grown in sufficient quantities in the pond most frequented by the birds if it is large enough; otherwise the system of unit ponds mentioned under planting (p. 20) may be used. Aquatic plants also may be gathered from any convenient source and thrown into the feeding pond. In the total absence of such plants, chopped-up grass, weeds, lettuce, or spinach, or even chopped roots and vegetables, may be used. Plenty of coarse, sharp grit should always be accessible to the birds, and it is well also to keep before them a mixture of ground-up oyster shells and charcoal.

CARE OF EGGS

Eggs are sometimes purchased when duck breeding is started, but they do not always bear shipment well. Better results are obtained from hatching the eggs of a well-acclimated stock of adult breeding birds, preferably individuals themselves reared in captivity.

Wild ducks lay early, and it is necessary to be prepared to care for the eggs in March and April. When the eggs are collected regularly, mallards will lay from 25 to 40 eggs each breeding season. Striving for maximum egg production involves the necessity of careful selection of breeders and keeping their average age at about 2 or 3 years.

Ducks are likely to lay early in the morning, and it is well to make the daily search for eggs by 9 a. m., so that the eggs will not long be exposed to possible attacks by vermin. Considerable skill developed by experience is necessary to find all the nests, some of which may be very cleverly concealed. To keep the duck laying in the same nest, substitute eggs of various types are kept in the nest until the bird ceases to lay. Some breeders substitute hen eggs, on the theory that since there usually would be more hen eggs than duck eggs in the nests, they would bear the brunt of any attacks by vermin. Others have found that if even a hen egg is eaten in a nest the duck will desert, and have resorted to wooden eggs of approximately the same size and color as those natural to the nest.

In gathering eggs, baskets and buckets are the usual containers, and when all the eggs are collected they are taken direct to a storeroom, where tables with a thick layer of sand, oats, bran, or other poor conductor of heat await them. It has been stated that sawdust, shavings, and excelsior are undesirable for this purpose, as they contain some oily matter, which may clog some of the pores of the eggs and interfere with respiration of the embryo. The eggs are placed on the tables in rows touching one another and are turned twice daily, morning and evening. In order that the handler may know which eggs have been turned, the more pointed ends of all should be placed in the same direction the first day.

A dry, cool cellar is an ideal storage place for eggs, and when the temperature ranges from 40° to 50° F. they may be kept safely for a fortnight before setting. When a cellar is not available the storage room used should be dry, and sunlight should be largely excluded.

Putting all eggs through this curing process and not setting them direct from the breeding cages, except in an emergency, contributes to uniform hatching. Time and energy will be saved, as a rule, by allowing eggs to accumulate until enough are on hand to set all the available hens. When there are more hens than are needed for one rearing field, set only enough to produce young birds up to the full capacity of that field. Eggs abnormal in any way should be rejected. It is customary also to reject a few of the earliest as well as of the latest eggs laid by each individual bird, as they are likely to prove infertile. Rejected eggs may be sold or used in food mixtures.

HATCHING COOPS

Hatching coops for duck eggs may be the same in every respect as those used for pheasants. A few types are described here, but the styles used are almost as numerous as the game farms using them.

For convenience and economy hatching coops are so planned that they can be used not only for housing the hens while they are incubating but also later when they are moved to the rearing fields to brood the young birds. The hatching coop illustrated in Figure 18 is 2 feet square, 23 inches high in front, and 12 inches at the back. The slatted door (1 foot high) is so constructed as to close, or, if slid to one side, to expose all openings between the slats forming the front of the coop. These slats are spaced so that the ducklings can run freely in and out of the coop, but so as to confine the hen. When it is desired to release her the sliding door shown at the left of the picture is raised.

The roof of the coop is 30 inches wide and 31 inches long and is provided with cleats on the lower side about 4 inches from each end that fit inside the walls of the coop and hold it in place. It should be nearly or quite rain-proof. The coop is made of ⅞-inch material and may look clumsy and heavy, but there is good reason for this construction. Storms do not easily unroof or overturn the coops and they stand wear and tear better. The roof should be weighted if necessary to prevent strong winds blowing it off. The advantage of its being rain proof and wind proof are obtained also by pyramidal construction of coops; or sometimes fibro-cement slabs are used for tops.

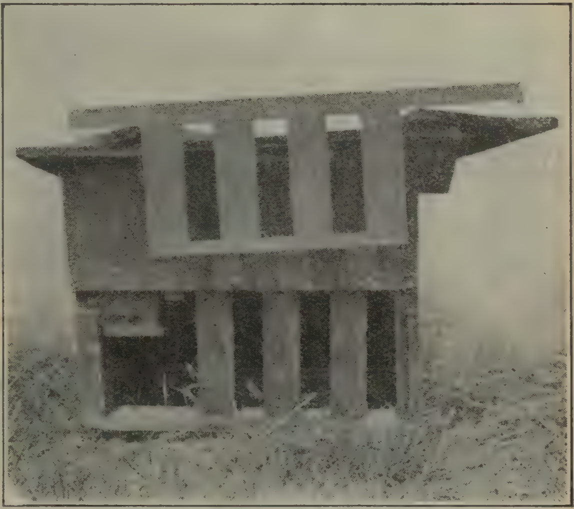

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FIGURE 18.—Hatching and brooding coop

In the view showing the interior of the hatching coop (fig. 19) is the nest holder, a frame 5 or 6 inches high and 16 inches square. One of these frames is used to hold the nest in shape, and a second is placed on top of the other at hatching time to prevent the tiny young from scrambling away from the warmth and shelter of the hen, which are so necessary to them at first. The hole in the upper front of the coop shown in Figure 19 is for administering sprays.

EXERCISING RUNS

For convenience and economy of time the hatching coops are arranged in rows with space at the sides about equal to their own width, and sufficient in the other direction to allow for a path and to accommodate the exercising runs. (Fig. 20.) These runs are simple frames, 36 inches long, 27 inches wide, and 23 inches high, covered with chicken wire on top and with 1-inch-mesh netting on two sides and one end. The top is removable, and the drinking cup is attached to the frame. These runs fit the front of the hatching coops and provide a place where the hen can exercise, be fed and watered, or confined whenever it is desirable to exclude her from the hatching coop. A similar coop and run are illustrated in Figure 23 also.

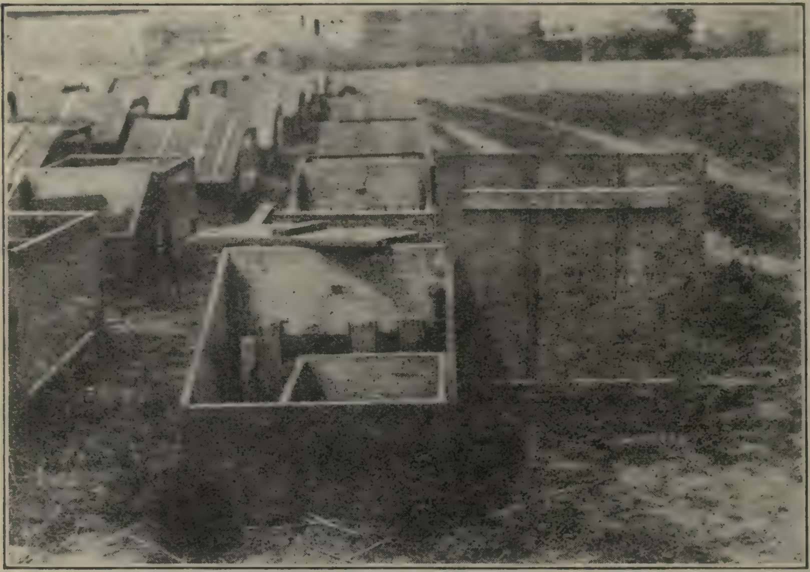

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FIGURE 19.—Interior of hatching coop

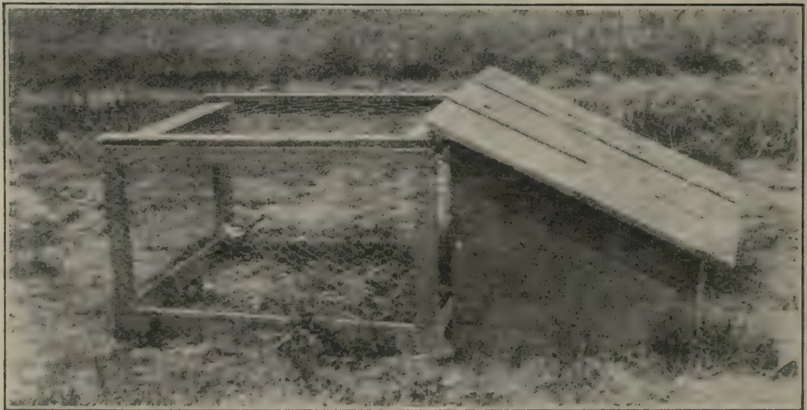

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FIGURE 20.—Hatching coop with exercising run

COMBINATION COOP

A combination hatching coop and exercising run is illustrated in Figures 21 and 22. The body of this is 30 inches square and is provided with two cleats on each side, so placed that a partition slid in them will divide the interior into two approximately equal compartments. The corner posts are 1½ inches square and the cleats of ⅞-inch and the walls of ½-inch material. The door on the side, 8 inches square, is hinged at the bottom and fastens with a button at the top.

The front of the combination coop is of 1-inch mesh, with a 3-inch slat across the bottom hinged to open upward, thus providing a place for the young birds to pass through. The button mounted on the block at the left side (fig. 22) holds the slat in position when fully opened. The coop is 18 inches high in front, 20 inches at the middle, and 15 inches at the rear.

The roof overhangs all around, and the back section is hinged and strengthened beneath by three cleats cut so as to hold it firmly in place when closed, the upper two cleats fitting inside the body of the coop, and the lower one outside. The front half of the roof is provided with two blocks upon which the rear half rests when open. This prevents undue strain on the hinges, and makes a level surface on which the caretaker may place anything he may wish to set down for a moment.

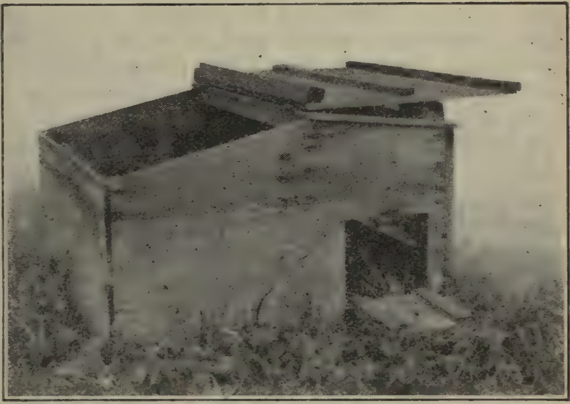
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FIGURE 21.—Combination hatching and brooding coop (side)

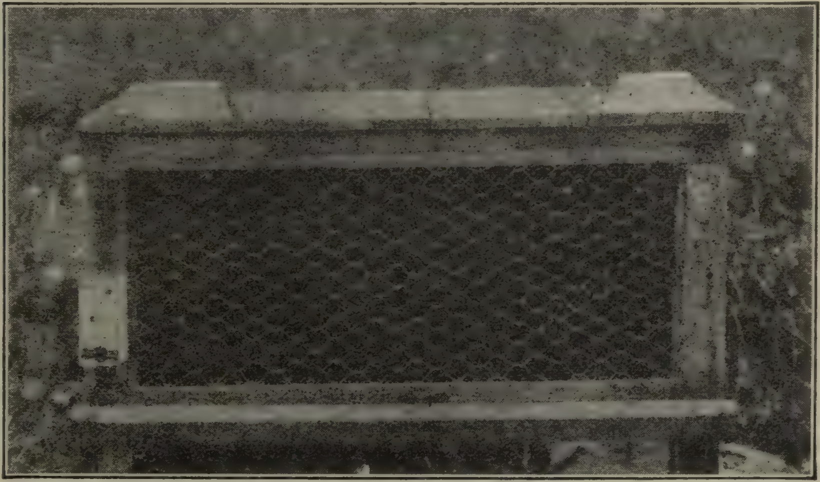
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FIGURE 22.—Combination hatching and brooding coop (front)

Setting boxes instead of hatching coops are used by some breeders and usually are built according to the battery system. In the simplest form nesting boxes are built in units of six compartments each, which have ventilating holes on three sides and a door in the other. Small feeding boxes in a series built to correspond are placed against the hatching boxes and the hens transferred to them for feeding and watering. The feeding boxes have a slatted front and a trough along it for the reception of food. Hatching coops can be kept out of doors without other shelter, in which case the eggs usually do not need to be sprinkled with water. At one game farm it was found that a common feeding and exercising run for the hens was best, as the birds thus mingled were placed on different nests from day to day, and the effect of differences in their body heat thus being equalized, a more even hatch was obtained.

Aggregations of these hatching boxes are sometimes placed in a hatching shed that has removable sides, so that it may be kept cool. For the same reason the floor of the shed, the hatching coops, and other things in the shed are sprinkled daily in hot weather. The turf or peat used for the foundations of the nest in the boxes is saturated with water at the time of building the nest, and in unusually hot weather the eggs are sprinkled occasionally.

An item of equipment sometimes accompanying the batteries of hatching and feeding boxes is a box of six compartments, each with a sliding top, which, loosely filled with straw, is used in transferring the young from the hatching shed to the rearing field.

MAKING THE NESTS

After the hatching coops or boxes have been disinfected by being dipped in an antiseptic solution, as of carbolic acid or creosote, or by thorough spraying with a commercial louse killer, a square of sod should be taken up and some of the soil removed from the under side so as to permit formation of a slight depression. This sod should be thoroughly drenched with water and placed on that where the coop is situated, giving enough elevation to assure that no damage will be done by heavy rainfall running in. Over the sod a smooth nest of straw or hay should be formed, dusted well with pyrethrum powder, and lined with grass clippings well worked in. Care should be taken to see that the nest is still well formed and smooth a day or two before hatching time.

INCUBATING

Preferences vary as to the type of hen to use for incubating eggs. but in general unfeathered legs, small size, and quiet disposition are desirable qualities. Hens obviously affected by scaly leg or any other fowl malady should not be used. With suitable broody hens on hand, it is well to accustom one for a few days to each hatching coop that it is planned to use. Putting in a few hen eggs may persuade her to adopt the nest, but these should not be replaced with duck eggs until the hen seems well settled down to her task. When satisfied regarding this requisite, place the eggs in a single layer in the nest, 8 or 12 of them according to the size of the hen, dust the hen thoroughly with pyrethrum powder, and allow her to return to the nest. Inspection in a short time will reveal whether she has properly adopted the eggs; and if so, she may be left in peace. If the hen does not promise to be a good close sitter, the eggs should be given to another at once.

During the 23 to 29 days' (average 26) incubation period, the hen should be carefully removed from the eggs and liberated in the exercising run once daily at a regular time, fed sparingly, and watered. Boiled whole corn, or scratch feed, grit, and charcoal should be her ration. If the day is warm she may remain off the eggs for an hour perhaps, but if cold or wet, the period should be decidedly reduced. The nest should be inspected daily for the purpose of removing broken eggs, washing soiled ones (in tepid water without soap), or rearranging the nest and eggs if not in the smooth and orderly condition necessary to get best results from the body warmth of the hen. It may be necessary also to turn the eggs, as not all hens attend to this necessary detail. The eggs should be sprinkled daily with tepid water. Hatching coops on the ground have an advantage in relation to moisture for the eggs. Care should be taken to keep close watch for lice, for if these become numerous they will annoy the hen so that she may give up brooding. In such case the coop should be disinfected, the nest renovated and powdered, and a new hen put on the eggs as soon as practicable. Meanwhile the eggs may be temporarily cared for in an incubator or in a flannel-lined basket by the kitchen stove. As a matter of routine, the hen should be dusted with pyrethrum after about 10 days of incubation, and again a few days before hatching time. Pure pyrethrum powder is insisted upon because some of the louse-preventive compounds contain ingredients that have been found injurious to young birds.

When incubators are to be used, larger numbers of eggs should be accumulated. The incubator should be run at a temperature of 103° F. and carried to 104° during hatching. The eggs should be turned, aired, and sprinkled with tepid water daily, and the air in the incubator should be kept moist by the evaporation of a never-failing water supply. Incubators are sometimes used to hatch eggs incubated under hens to prevent loss of ducklings by trampling.

Young hatched in incubators, as soon as dry, should be put under broody hens so that they may learn to nestle before being placed on the rearing field.

HATCHING

As the day approaches when hatching may be expected, the first signs of pipping should be watched for. From this time until the young birds are all hatched and thoroughly dry, the hen usually will stay continuously on the nest and should not be disturbed. The second story of the nest frame described in the section on "Hatching Coops" (p. 25) should be placed about her; this will prevent the tiny young from scrambling away from the hen, when they may perish from cold. Until the hen leaves the nest voluntarily after hatching she should not be fed or removed for any reason. She should have full charge of the young for 24 hours after hatching is completed. They do not need food at this time.

REARING

Shortly before the rearing field is needed for use single swaths should be cut in it from 50 to 100 feet apart. The hatching coops should be spaced 50 to 80 feet apart in the swaths, so as to allow for moving them 3 or 4 or more feet daily for 8 to 10 days. The shorter grass in the swaths makes the work of the keepers in moving coops, watering, and feeding far easier and renders it less disagreeable on dewy mornings. The coops can be kept close to the uncut grass, so that the ducklings can easily reach it when taking cover. A little banking of soil around the coop is sometimes necessary to prevent water from draining into it. The coops should be placed on the rearing field a few days before needed, and in fine weather, so that the ground under them will be dry.

After the 24-hour drying period, the hen should be removed with her brood (the hen in a sack, the young in a covered basket well filled with straw) to a coop in the rearing field. The hen is then confined to the coop, which for the first three days should be provided with a small run made of three boards a foot wide to keep the young from straying. The lower edges of these boards and the walls of the coop should fit the ground closely and have no holes through which the ducklings can escape. The runs should be covered also with wire netting and either set in partial shade or provided with screen (small homemade "tables," 4 by 6 feet with 18-inch legs, are good) against the strong, direct rays of the sun, exposure to which will quickly kill the young birds.

Confining the young for three days gives them a chance to get well acquainted with their foster mother, and what is especially important, to learn her calls. Some breeders maintain that this can be accomplished by shutting up the birds for a few hours with the hen in the rearing coop. After the fourth day the board run should be removed and the position of the coop changed a few feet every day.

Hens seem prone to scratch more than usual after the irksome confinement of the incubation period, and scratching in the rearing coop is dangerous to the young birds. Some breeders prevent it by setting unfloored coops on burlap bags for the first few days, while others floor the coops with wire netting or even boards.

The hens are confined to the coops at all times on the rearing field and fed whole corn (best boiled), grit, and charcoal. The young are weaned from them at the end of three weeks and placed in subdivisions of the rearing field with plenty of shade available.

Contrary to popular impression, ducklings when brooded by hens do best if kept away from water until their bodies are well feathered; that is, until they are about 8 weeks old. When brooded by ducks their plumage is kept oiled, and wetting does not hurt them. At earlier stages whenever their plumage begins to be fouled let them bathe in shallow pans of tepid water for a short time on warm, bright mornings.

The regular supply of water may be furnished safely in good-sized baking pans lined with green turf that is then barely covered with water. This prevents the ducklings from getting their backs wet (thus guarding against chilling and more serious disorders) and gives them employment probing mud and nibbling grass. The water should be shaded, and frequently and completely renewed to keep it cool and wholesome.

At 8 weeks of age all ducklings may be allowed to run together, a warm morning being chosen for their introduction to the pond where they are to mature. For the first few days they should not be allowed to stay in too long, but should be driven into the dry compartment of an inclosure consisting of a wire cage in the water and a shed on shore. This should be their permanent feeding and roosting place, where they can be penned whenever wanted.

FEEDING DUCKLINGS

Fine grit, mixed with a little ground charcoal, should be before ducklings from the very first, as well as water in drinking fonts in which they can dip only their bills. The first feeding, when they are a day old, may be finely ground hard-boiled egg mixed with cracker crumbs or rolled oats, and a little sand, the mixture being no more than crumbly moist. The foster mother should be fed with grain to prevent her taking all the ducklings' food. For the same reason, as soon as the ducklings have learned to eat, it is better to feed them outside the coop.

Feeding at first should be in small quantities and as often as five times a day. In a few days the meals can be cut down to four and later to three. After the first day a good feed is 3 parts oatmeal and 1 part commercial duck meal, scalded and fed only crumbly moist. Sprinkle in this mixture somewhat less than a tenth its bulk of coarse sharp sand and about a quarter by bulk of hard-boiled eggs, ground shell and all.

After one week the base of the food may be varied with barley meal, bran, and middlings. Continue this a week, then gradually reduce the egg until at three weeks none is given. At this time add good beef scrap until it forms 10 to 15 per cent of the food, and begin giving in the mash small mixed grains, which can be increased in quantity and size as the ducklings grow. Little corn is given until the birds are practically grown. Abundant chopped green food, as grass, lettuce, and rape should be given from the first; nothing is better for the purpose than water plants, especially duckweeds.

OTHER DUCKS

No fewer than 27 species of North American ducks have been bred from captive parents, and several others have been reared in captivity from eggs or young taken in the wild. Some have been bred only a few times and with difficulty, but gradual increase in knowledge of how to handle the birds indicates that a number of the species can eventually be bred as extensively as desired. The great desideratum in all cases is establishment of a breeding nucleus of hand-reared birds. Possessing such a stock the experienced breeder will hardly admit that there are any further serious obstacles to success with most of the species.

The rearing methods outlined for the mallard (pp. 22–31) are best for quantity production. In most respects they can be adapted to rearing small numbers of ducks, but it is possible in the latter endeavor to adopt refinements of method and special treatment for individual species that have been found helpful in efforts to breed them.

PENS

When it is desired to keep a variety of species of waterfowl breeding true, or if the collection includes birds of markedly different sizes (the larger of which are invariably, and even dangerously aggressive), separate inclosures should be constructed for the different kinds or at least sizes, each containing both land and water. It is well to have more of these fenced areas than will be actually in use at one time, so that empty ones can be renovated and a growth of grass or other green food restored. It is an advantage to have the subdivisions screened by dense hedges, and if space permits shrubbery should be included in each to provide the shade and cover the birds so evidently appreciate.

CONTROL OF ENEMIES

With smaller numbers of birds greater precautions for the control of enemies can be taken because of the usually smaller areas involved, and such precautions are often highly desirable also on account of the much greater value of the stock. On the farm where mixed species of valuable waterfowl are being reared, a vermin-proof outer inclosure should be regarded as of first importance. Inner partitions and pens should also be vermin-repelling, and traps of the type taking live captures should be constantly set, and, be it not forgotten, constantly inspected to permit the release alive of game birds or other innocent victims. Hatching boxes without bottoms may be guarded by being put in an inclosure of vermin-proof fencing, which for greater safety should have a complete floor of wire mesh buried in the earth. Hatching and rearing coops also may have a solid board floor and substantial door, so that they may be entirely closed at night. When such hatching boxes are used greater care will have to be taken to give the eggs plenty of moisture.

How the point of view alters cases is shown by the fact that the mallard, the principal object of production on most aquatic game-bird farms, is classed as vermin by breeders of fancy ducks. The mallard is freely polygamous, and its tendencies in this respect have to be strictly controlled on game farms where the production of other species in pure strains is desired. In fact, at establishments specializing in the production of a wide variety of duck species, mallards, because of their promiscousness, are regarded as a pest and so far as possible excluded.

CARE OF EGGS

One point to watch in egg production from especially valuable birds or those from which eggs are desired the following year is not to drain the female completely by continued removal of eggs from the nest. Her cycle of egg laying can be terminated by giving her a setting of mallard or even hen eggs, and if this is done, she is likely to produce normally the next season.

Frequently ducks being raised in small numbers are allowed to complete their first clutch and hatch and rear their own young. Under this system not so many eggs are laid, and while the method may serve in some cases, in general it is risky. Accidents of various kinds often cause considerable losses; the young may die from insufficient nourishment or from too much bedraggling; in a word, they are less under control and can not be so well tended as those that are penned with hens. Some breeders compromise and allow ducks to incubate their eggs up to near hatching time, when they are removed and put under hens.

The period of incubation of some of the commoner American ducks has been reported as follows: Black duck, 26 to 28 days; teals, 21 to 23 days; pintail, 22 to 23 days; wood duck, 28 to 30 days; redhead, 22 to 24 days; canvasback, 28 days; and goldeneye, 20 days.

CARE OF YOUNG

In general, the care and incubation of eggs are the same as described for the mallard. In the case of the young, smaller inclosures are the rule, and it is seldom that the typical rearing-field system can be used, because young birds of different species, and even of distinct sizes of the same species, must be kept in separate pens on account of the tendency of hens to peck at and even kill young differing noticeably from the brood they have at the time.

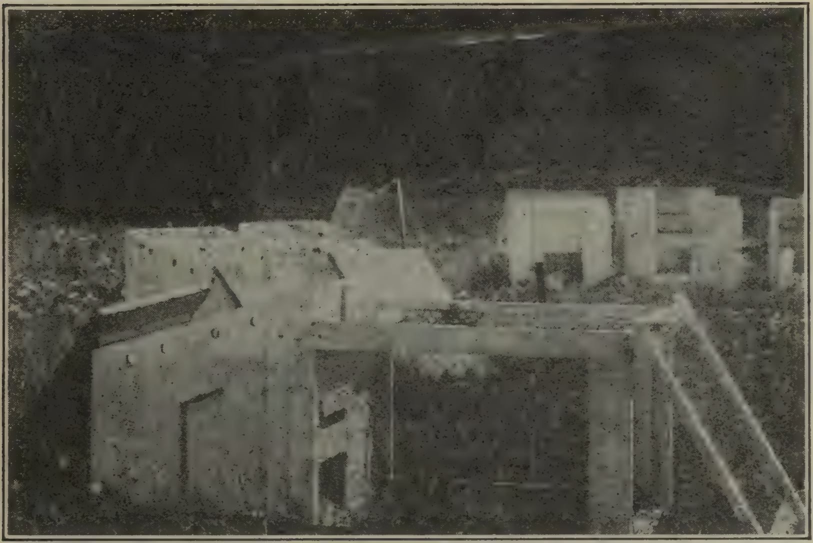
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FIGURE 23.—Coop that can be used both for hatching and rearing; heavy construction makes for durability, coolness, and stability in windy weather. The small run in front of the coop may be used as an exercising range for a sitting hen or for ducklings their first few days; in the rear are coops in a temporary run of wire netting, and in the background a shed housing hatching boxes

The use of small inclosures hastily improvised is illustrated in Figure 23, as is also a somewhat different type of hatching and rearing coop and portable range from those figured in the account of the mallard. (Fig. 19.) A rearing coop adapted for use in cool climates is shown in Figure 24. A good type of small pen including grassy range, bathing pool, rearing coop, and small range is illustrated in Figure 25. The shallow concrete basin is especially commendable, as it is easily swept out and scrubbed clean.

Practice varies in respect to admitting ducklings to water from the first or at some more advanced age, and success has been obtained in both ways. When ducklings, especially small ones, are allowed access to water, however, there is added responsibility for seeing that their plumage does not become water-soaked, and greater care is necessary in cool or rainy weather. It may be necessary at any time to gather up a bedraggled brood, tuck them cozily in flannel, and warm them by the kitchen stove. A precaution that can be taken against wetting is setting unfloored rearing coops on burlap bags that will absorb moisture, and changing the bags each day. It has been found also that clipping off the tail feathers of ducklings greatly reduces the quantity of water they carry into the coop and thus keeps the hen drier in brooding them. This tail clipping is done at the same time as pinioning and serves for some time as a convenient means of telling which birds have been pinioned.

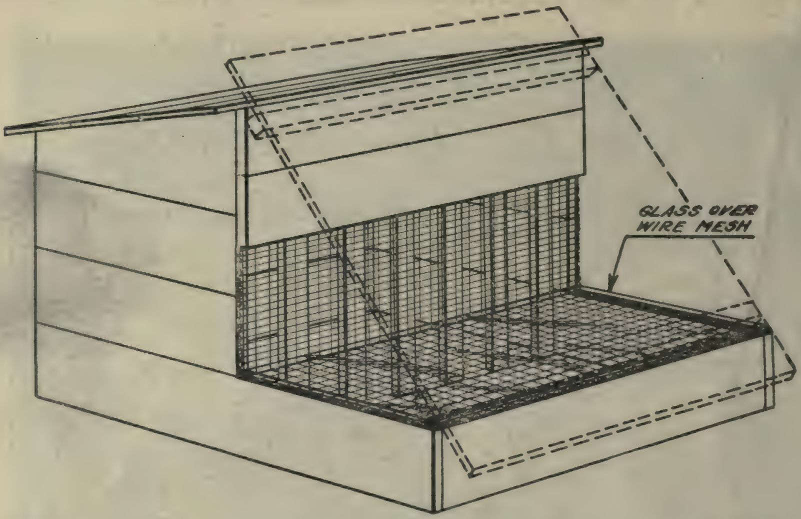

FIGURE 24.—Rearing coop for cool climates. The roof (screen shown in outline) and two similar pieces (not shown) are of identical construction and are used for shade, shelter against winds, and otherwise as needed. The wire-topped runway is covered with heavy glass during cold or rainy weather. A glass plate can be used also to close the slat-and-mesh portion of the front above the top of the run

Even when ducklings are put on water from the first, it is usual to provide only a small and shallow pool to start with, and to transfer them as they grow successively to larger pens with larger and deeper pools.

FOOD

Feeding may be more easily diversified for small than for large numbers of ducks, and it is more expedient to use commercial preparations. Mixed flocks of fancy ducks as a rule are fed richer foods than are the birds on a strictly mallard farm. The older ducklings and adults before and during the breeding season are given a mash rich in meat scrap or the like, according to some breeders the richer the better, expense being the check upon the quantity of animal matter in the food rather than any necessity for restriction so far as the welfare of the birds is concerned.

Animal food used includes meat scrap, both commercial and homemade from various sources, cooked liver, fish meal, chopped raw fish, ground raw or cooked rabbit, and even the bodies of birds and mammals killed as vermin. Ducklings are given such special foods as cleansed and scalded maggots, meal worms, and chopped earthworms. Duck farmers seem unanimous as to the great value of duckweeds for ducklings, and it is well to have at hand sources of an almost unlimited quantity of these. It has been found that grass clippings are a good substitute for duckweeds, and growing grass should always be available to ducklings.

In small-scale operations, commercial drinking-water fountains and hoppers for any dry foods given are being used more extensively. Fountains should always be shaded.

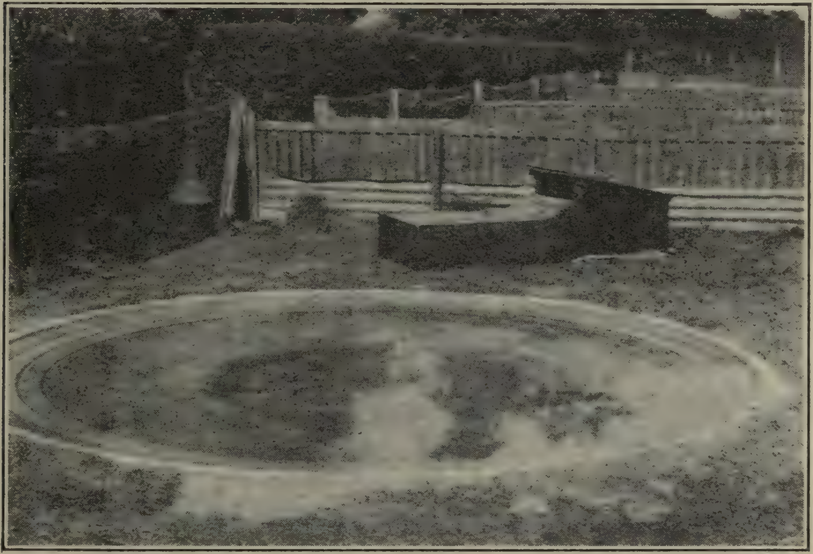

FIGURE 25.—Rearing coop and pool for ducklings in a small pen

When the birds have plenty of range they will obtain a great deal of natural food and may require artificial feeding but once a day, except when being prepared for, and while actually engaged in, producing eggs and rearing young, and in winter.

NOTES ON SPECIAL GROUPS OF DUCKS

MERGANSERS

There appear to be no records of the breeding of mergansers in captivity. Probably the difficulty of providing their chief natural food, namely living fishes, is the chief obstacle to success with the fish ducks.

BLACK DUCK

The black duck, often called the black mallard or dusky duck, is of a more wary and nervous disposition than the common mallard, but nevertheless has been bred in large numbers in confinement. Once a breeding stock of captive-reared birds is available, the black duck seems no more difficult to rear than the mallard.

WOOD DUCK

The beautiful wood duck is hardy in confinement and thrives even in small inclosures. At all ages wood ducks have surprising climbing abilities, which make it difficult to limit their movements. They are particularly inclined to roam at the approach of the nesting season, and for this reason unpinioned birds have an advantage, as they are better able to escape danger when roaming and can get back home more readily. Full-winged birds, if not disabled, may be depended upon to return to the place where they have been reared, and they are said to breed better than pinioned ones. Wood ducks usually breed only in nest boxes, which have already been described (p. 5). The ducklings are rather delicate at first and sometimes slow about starting to feed. It seems easiest to get them interested in something alive and moving, as fresh-water shrimp; in the absence of these, meal worms or scoured maggots might be tried if the mash continues to be ignored.

OTHER SHOAL-WATER, OR RIVER, DUCKS

In general, the shoal-water ducks are easier to keep and have bred much more freely in confinement than the deep-water species. The various teals and widgeons have been bred on every game farm that has had even a modicum of success, and the gadwall and pintail do well in captivity. The shoveler is said to require more animal food than the other species and probably prefers it in a finely divided form.

DEEP-WATER, OR DIVING, DUCKS

In a state of nature the deep-water ducks inhabit deeper water and partake more extensively of animal food than the shoal-water species. A number of the species have been bred in captivity, but on the whole they are much more difficult to rear than are the river ducks.

Conditions satisfactory enough to induce redheads and canvasbacks to lay at an Ohio establishment were afforded by half an acre of springy, flooded woodland, containing stumps, logs, tussocks, bushes, and an abundance of duckweed. The pond was inclosed by vermin-repelling netting and partitioned to separate the different species. Young redheads hatched under hens and reared with them for some weeks were returned to the pond and added to a brood reared by a female redhead, which adopted the newcomers without delay. This female redhead kept her own young away from the water for two days after hatching. It was necessary to trap owls about the woodland pond, and hawks were kept away by hanging up brightly colored papers.

Ducks of the scaup or bluebill group have been very resistant to efforts to breed them. Goldeneyes have been bred; they nest in boxes like the wood duck, and thrive if given plenty of ground fresh fish. The common eider seems to have tendencies toward domestication, evidenced by its nesting in dooryards and permitting handling in countries where its down and first clutches of eggs are harvested.

These birds have been bred by keeping them on a salt-water pond and feeding them entirely animal food, cooked or raw rabbit to the adults and chopped earthworms to the ducklings.

TREE DUCKS

Jean Delacour[9] gives the following brief summary of his experience with tree ducks:

> In very cold places they feel hard frost and it is wise to shut them up for the winter; but in the milder parts of France and England they may stay out all the year round except in unusually cold weather. Being as a rule very tame and non-migratory, they may usually be left full-winged and will not abuse the privilege. I must say that all those which I have kept full-winged for years, though they sometimes take flight, never stray away.
>
> Imported birds (and almost all are imported birds) do not breed readily, but once young can be obtained in cofinement, they reproduce themselves abundantly; each female lays about thirty eggs between April and August. The young are rather delicate and grow slowly. Both adults and young are fed like other ducks. They do not go into eclipse plumage and the sexes are identical and impossible to distinguish. As a rule they are inoffensive birds, but a few males may turn bully, which may be tiresome, but is not dangerous.

CANADA GEESE

The Canada goose is rather easily reared from pairs reconciled to captivity; the birds ordinarily are allowed to hatch their eggs and rear the young, which they do with an amazingly high percentage of success.

RANGE

Geese need room, and the ideal range should include a pond or a section of lake or sound shore, together with ample pasturage and some shade. Shelters other than natural cover are not required. Pinioned birds (and the primary stock of most breeders will be pinioned) need protection, especially from dogs. A dog-proof fence is needed about the breeding area at least, and if the goslings are to be protected from small vermin the lower 2 feet of the fence should consist of 1-inch-mesh wire netting or of boards, in either case with an overhang at the top of this section.

BREEDING STOCK

Propagated geese are more desirable as breeders than birds captured in the wild, for the latter may not mate and settle down to breeding for several years, whereas reared birds sometimes breed when 1 year old. Geese must be allowed to select their own mates. They remain mated for life, and it is advisable to handle them in mated pairs and not attempt to break or mix pairs. These birds live to a considerable age (50 years or more) and are better breeders in late than in early life. It is well to have room enough for the pairs to be well separated during the mating season, and other birds on the farm, especially young, should be kept away from the geese, which may attack them.

In localities where geese can easily glean a living in winter, it has been found that propagated birds will remain about their home, even if not pinioned. In most cases, however, it will no doubt prove desirable to render the birds incapable of flight. Directions for pinioning are given on pages 21–22. (Fig. 17.) Family loyalty is so strong among geese, however, that usually all will remain if only one or two of each family are incapable of flight.

---

[9] DELACOUR, J. Avicultural Mag. (4) 6 (2): 43–44. 1928.

NESTING

Geese are somewhat temperamental about their first nest and should be left entirely undisturbed when mating and selecting their first nesting site. In succeeding years they more boldly select and hold their chosen home, resorting when possible to the site of former years. If the range has tussocks of grass, no nesting material need be furnished; in their absence it is advisable to supply hay or straw. Nesting takes place early in spring, and the number of eggs varies from 4 to 7, the usual number being 5. The female sits very close, and the gander zealously guards the nesting site. The incubation period is 28 to 30 days. During this time the birds must be fed and watered near the nest. Intensive breeding methods also have been successfully tried with Canada geese, two and three clutches of eggs being obtained from each pair. The extra eggs are hatched under hens.

CARE OF YOUNG

If on good pasture, where they can get all the green food they want, the goslings require little care other than that given by their parents. It has been found best to prevent them from getting into water until they are about 10 days old. During this period drinking water should be supplied in fountains in which they can dip their bills only. The water should be renewed frequently and kept in the shade. Shade is necessary also for protection of the goslings from heat.

FOOD

Geese are primarily grazers and can live indefinitely on pasture that will support cattle. Rye furnishes good winter pasture, and millet or mixed grasses satisfactory summer range. Before and during the breeding season, it is advisable to feed grain. Almost any kind will be eaten, but a mixture of 75 per cent whole oats and 25 per cent corn is recommended before egg laying, and just the reverse of these proportions during the incubation period. Oats and a little corn are fed regularly in winter, especially when pasturage is not available, and at this season cabbage, apples, turnips, and the like can take the place of green feed. Ground hay and alfalfa also are good.

Goslings as well as the adults can subsist wholly upon green food. but some breeders advise feeding them lettuce and stale bread moistened with sweet milk. This is laid on a board where it will dry up rather than sour, if not eaten. When the young are 10 days old and browsing actively, a supplementary ration of soaked oats, cracked corn, or scratch feed may be given. When they are growing their feathers, feed whole wheat. Keep a plentiful supply of ground oyster shells and clean gravel always available.

OTHER GEESE

All the North American species of geese, except the sea brant, have been bred in captivity. No special directions are necessary for the care of these species except the emperor goose. As this northern bird can not stand heat, it does best in cool, humid localities provided with running water. The young must have plenty of cool water and shade. The emperor goose requires animal food, and the most successful breeder has used dried shrimps for the purpose. No corn is given.

SWANS

Although swans are classed as migratory game birds, there is no open season on them anywhere in the United States. One of our two native species, the trumpeter swan, is so rare that no permits are issued for trapping any swans in the region—British Columbia, Alberta, and Montana—where small flocks of trumpeters are still known to exist.

STOCK

Breeding stock of several species of swans may be obtained from dealers, a list of whom will be furnished if a request is addressed to the Bureau of Biological Survey. Swans are slow to mate and remain mated permanently. The only satisfactory way to buy them, therefore, is in guaranteed mated pairs. Under normal circumstances never separate the birds of a pair. It is necessary to pinion swans, as the birds are not sure to return home if allowed to fly. Directions for pinioning are given on pages 21–22. (Fig. 17.)

RANGE

Swans are large and aggressive birds and must be given plenty of space. If the available range is not large enough for the pairs to separate when they choose, thus preventing constant fighting, an ample pen should be wired off for each pair. The birds can not keep in good condition without access to water, and if a body of water is available large enough to maintain plant growth for natural roughage, so much the better.

FEEDING

Swans graze, but not so extensively as do geese. Grass, clover, and especially alfalfa are suitable green foods, and it helps a great deal if a growth of water plants is available to the birds. If not directly accessible, some of these plants should be gathered occasionally and fed, or such plants as lettuce, kale, and spinach can be substituted. Water plants are a very necessary element of food for the cygnets, or young. In addition to roughage, swans must have grain, and this is usually thrown in the water for them; any small grains will serve. Grain given to cygnets should be soaked over night; but oatmeal is preferable for them. In winter, clover and alfalfa hay, chopped roots, bran, oats, and a little whole corn may be fed. Bread and root vegetables cut in sizes convenient for swallowing also are sometimes given to them. Plenty of grit and clean water should always be available. Swans are slow feeders and should be fed apart from ducks, geese, or chickens. If this is not feasible, place their food in a pail on a box and wet it thoroughly.

BREEDING

Swans, like wild geese, are allowed entire charge of family affairs. They pair very deliberately, but for life. They are particular about nesting sites and are said to take most readily to small islands. If natural conditions do not permit thorough separation of the pairs, fences must be used. Adults not only fight among themselves, but will kill the young of other pairs. The incubation period of the whistling swan is 35 to 40 days.

WINTERING

Swans can winter in the Northern States in a shelter partially open to the south and deeply littered with hay or straw to protect their feet. Where their swimming pool does not freeze over, no winter shelter is required.

OTHER AQUATIC AND SEMIAQUATIC GAME BIRDS

Some species of rails, coots, and shore birds have been propagated in captivity but as yet scarcely on a scale interesting to the game breeder. The Bureau of Biological Survey, however, will gladly aid inquirers to get in touch with existing information on the subject.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

December 10, 1929

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This bulletin is a contribution from

Bureau of Biological Survey	Paul G. Redington, *Chief.*
Division of Food Habits Research	W. L. McAtee, *Senior Biologist, in Charge.*

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PROPAGATION OF UPLAND GAME BIRDS[1]

By W. L. McAtee, *Senior Biologist, in Charge, Division of Food Habits Research, Bureau of Biological Survey*

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INTRODUCTION

THE METHODS OF REARING game birds suggested in this bulletin reflect the practices of the most successful breeders. Most space is devoted to directions for the care of species that have responded best to the methods of artificial propagation. Management of species that have proved less adaptable thus far to hand rearing is outlined in a more tentative way. Success to date with the most responsive birds, however, indicates that increase of production can be carried to practically any extent desired

GENERAL CONSIDERATIONS

LICENSES

Most of the States have laws or regulations affecting the propagation of game birds, and many require game breeders to take out licenses. The Bureau of Biological Survey, United States Department of Agriculture, Washington, D. C., supplies digests of State laws on game-bird propagation and the addresses of officials to whom application should be made for State licenses and for the full text of State laws relating to the propagation of game birds. No Federal permits are required in connection with the propagation of upland game birds.

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[1] The following publications may be had free on applying to the United States Department of Agriculture, Washington, D. C.: McAtee, W. L. PROPAGATION OF AQUATIC GAME BIRDS. U. S. Dept. Agr. Farmers' Bul. 1612; PUBLICATIONS OF INTEREST TO GAME BREEDERS. U. S. Dept. Agr. Bur. Biol. Survey Leaflet Bi–203 [mimeographed]; DEALERS IN GAME AND ORNAMENTAL BIRDS. Bur. Biol. Survey Leaflet Bi–458 [mimeographed].

SITE

AREA REQUIRED

Small numbers of game birds can be reared with more or less extemporized equipment moved about within the confines of a roomy dooryard or in a small orchard. Game-bird propagation on a sustaining and business basis, however, requires plenty of room. For reasons to be explained under the heading "Crop rotation," the area of land available should not be less than four times that required to care for the birds properly for a single year. Plenty of space is needed for the further reason that in most cases it is desirable to produce birds that will be as wild and wary as possible. These qualities improve the chances of planted birds escaping natural enemies and can be achieved to the maximum only on grounds where the birds can roam with the least restraint.

SOIL FERTILITY

To be successful, the propagation of game birds must be on a crop basis. On the efficient and economical game farm as much as possible of the seeds, grain, and forage consumed by the birds must be produced on the ground. Insects, so necessary an element in the food of the young, must be wholly of local origin. This vital food supply, a substitute for which is so difficult to find, and which in most cases more than any other factor decides the success or failure of game-bird production, depends almost directly upon soil fertility, for insects can subsist in abundance only upon rank vegetation.

No land is too good for a game farm. Those who hope to succeed on tracts useless for other purposes, on barren areas where almost every particle of food consumed by the birds must be brought in and hand fed, will rear their birds only at much greater cost of efforts and funds, and probably will suffer many disappointments. In such places the vitalizing elements are lacking, and it will be difficult if not impossible to produce there the healthy, vigorous stock necessary for continuous maintenance of a game farm.

CROP ROTATION

Soil fertility is not only an initial requirement for the successful game farm; it must also be maintained. In fact, the purely agricultural phases of the game farm must be managed with just as much foresight and care, and in much the same way, as a hay or grain farm that is kept on a profit-yielding basis. Proper cultivation of the soil is important, not only in preserving the basis of production but also in rejuvenating the land after the fouling that is unavoidable when large numbers of birds have been kept on it for some time.

Plowing, fallowing, fertilizing, planting, and cultivating are as essential to the upkeep of the farm upon which game birds are the crop as on any other. To rest and renovate fields upon which a crop of birds has been reared it is advisable to follow with little change the scheme of crop rotation that has been found satisfactory in the region concerned.[2] The special object of crop rotation on the game farm is to end it with a mixed growth of hay-producing plants as lush, luxuriant, and healthy as it is possible to produce. In such an environment breeding stock can be kept vigorous and productive, and young birds can be reared quickly and with the smallest losses. Cultivate as smoothly as possible so as to give many nearly level spots on which coops can later be placed.

---

[2] Information on crop rotation and publications on the care of the crops recommended may be had from the Bureau of Plant Industry, United States Department of Agriculture.

As a sample of rotation methods, those in use on the New York State game farm, at Sherburne, may be cited. In the short or 2-year rotation the land is broken, cultivated, and planted to corn immediately after its use, either as a breeding or rearing field, in the spring. When the corn is taken off in the fall a mixture of timothy, clover, and redtop seed is sown, and the field is used for birds again the next year. In the long rotation oats or wheat follow the corn, extending the round one year.

WATER SUPPLY

A copious supply of good water is a necessity for the game farm, and assurance of its existence and dependability should be obtained before proceeding further. In arid regions especially success is dependent upon water. Even in such areas, however, with a plentiful source of good water and a sprinkling system installed in the propagating inclosures, conditions of more humid districts may be satisfactorily imitated, including the growing of cover crops.

SANITATION

Birds are unable to tell of their discomfort, and often no difference in appearance or behavior can be noted before one is sick unto death. Treatment then is generally ineffectual. From every point of view the watchword should be "prevention." One cardinal rule for the game farm is to keep the living quarters of the indispensable poultry always entirely separated from those of the game birds. Domestic fowls have diseases to which they are more or less resistant but which may carry off captive game birds like a plague. It is well even for the sake of the poultry to change their quarters occasionally and to renovate the land; but under no circumstances should ground fouled by poultry be used for game birds until it has been baked by the summer sun, frozen by the winter cold, and plowed, fallowed, planted, and renovated to the last degree of thoroughness.

The prevention of disease depends to a great extent also on the policy followed in respect to the introduction of new stock on the game farm. On a going farm it pays to let well enough alone. The acquisition of fresh stock is fraught with such danger that it should not be undertaken except when the need is unmistakable. The fertile, well-managed game farm will have vigorous healthy stock, and once having it, a reasonable degree of selection being exercised, the owner need give no consideration to the fear of inbreeding. When for some important reason it has been decided to bring in new birds, they should be held for observation for some time before they are allowed to mix with the regular stock. For this quarantining, roomy and sanitary inclosures should be provided, since crowded quarters in themselves tend to promote disease.

CONTROL OF ENEMIES

After disease, feathered and furred flesh eaters, popularly called "vermin," are the worst obstacles to success that the game farmer has to overcome. Among birds, Cooper's hawk is probably the worst pest on upland-game-bird farms, with the sharp-shinned hawk, great horned owl, and crow scarcely less important. Sometimes other hawks, as the red-tailed and the red-shouldered, are tempted by the plentiful supply of food offered by a well-stocked game farm; but, as these hawks are habitual mousers, warfare against them should be upon individuals proved to be rogues and not upon the race. Even the ordinarily beneficial little sparrow hawk at times can not resist an easy chance to pick up young pheasants. Owls other than the great horned owl are occasional marauders, and even crow blackbirds (grackles), red-headed woodpeckers, and blue jays sometimes become destructive to pheasant chicks.

Among mammals the most dangerous enemies of birds on game farms are cats, free-roving dogs, rats, and weasels; of less importance are minks, foxes, badgers, skunks, opossums, and raccoons. Even the little ground squirrels or picket-pins of the prairie States eat the very small young of game birds. Snakes sometimes figure prominently as egg thieves.

These various animal pests find a center of attraction in game farms, and the necessity for their control in such places is freely admitted. Efforts along this line, however, are apt to vary widely. Some are well considered, selective, just, and sensible; others are blundering, indiscriminate, unnecessarily cruel, and fanatical.

FENCING

Usually the main dependence for predator control is appropriate fencing. The entire farm may be surrounded by a permanent vermin-proof fence; or the rearing or breeding fields may be guarded either by semipermanent fences, or even by temporary and easily movable fences that will exclude most natural enemies; or all such fencing may be dispensed with and only the bird pens themselves used to give protection. The pens are usually built so as to keep out both ground and winged enemies.

PERMANENT FENCE

Fencing of a type deserving to be called permanent is expensive—prohibitively so in most cases where profits are an object. Suggestions, however, as to the construction of such a fence may be in some demand, and hence are given here. The permanent fence should have concrete posts and foundation of equal thickness, the latter extending about a foot both above and below the ground, and into the upper part of it the woven wire should be embedded. All mesh should be of the type galvanized after weaving. The lower course of 30 to 36 inches should be of ½-inch or ¾-inch mesh and should have extending outward from its upper margin an overhang 1 foot wide of the same mesh. The upper part of the fence should be of not more than 2-inch mesh, and the top of it supported by a tightly strung barbed wire. Several other closely spaced strands of barbed wire or another overhang should form the top of the fence. The total height, excluding overhang, should be at least 8 feet. Modifications that may be made in this fence that will not seriously affect its permanency are the use of creosoted poles for all but corner and gate posts, and creosoted cypress (pecky for economy) planks 1 by 6 inches, instead of the concrete base.

SEMIPERMANENT FENCE

The ordinary semipermanent fence (fig. 1),[3] generally used where the degree of protection it affords is sufficient, departs from the ideal in several respects. However, wire galvanized after weaving is preferably used. The posts are all wood, creosoted at the base if possible; the mesh of the lower course is 1 inch, and about 6 inches of this strip is buried in the ground. The overhang if placed at the top of this width is of the same mesh, for it is wasteful to use for an overhang mesh smaller than that which it surmounts, because small climbing predators will go through the first openings they find large enough.

The upper course of the ordinary fence is of the familiar poultry netting (2-inch mesh), and the overhang (1 to 3 feet wide) at the top is of the same material. The height should be 8 feet but sometimes is only 7. It is well to have a supporting strand of barbed wire along the top to keep the fence in better shape and especially to resist the weight put on the netting by sleet storms. It may be necessary also to reinforce a netting fence with barbed wire strung where horses, cattle, or hogs may come in contact with it.

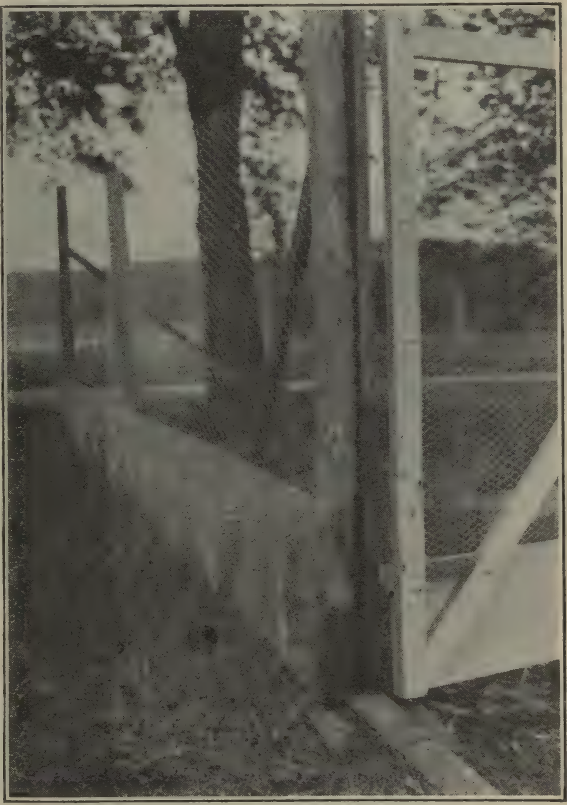
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FIGURE 1.—Semipermanent vermin-repelling fence

TEMPORARY FENCE

Where the vermin problem is not serious or where general activity against predators keeps them under such control as not to involve too great risks, temporary or portable fencing is used to advantage. The supports for such fences are light poles put in holes made with a crowbar. The lower course (3 feet) of the fence is of 1-inch mesh (sometimes closer when it can be afforded) that has a single furrow turned over its base. The upper part (6 feet) is poultry wire without overhang. The two strips of mesh are pinned together with nails. This fence can be quickly and easily moved from one field to another, and on account of the frequent rolling and general wear and tear that it undergoes, for economy it is usually made of wire galvanized before weaving.

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[3] Of the illustrations in this bulletin, Figure 14 was contributed by the Conservation Commission of New York, the cover cut and Figure 28 by J. Carlton Hunting, Figure 26 by the late Samuel C. Evans, and Figure 27 by D. H. Beyea.

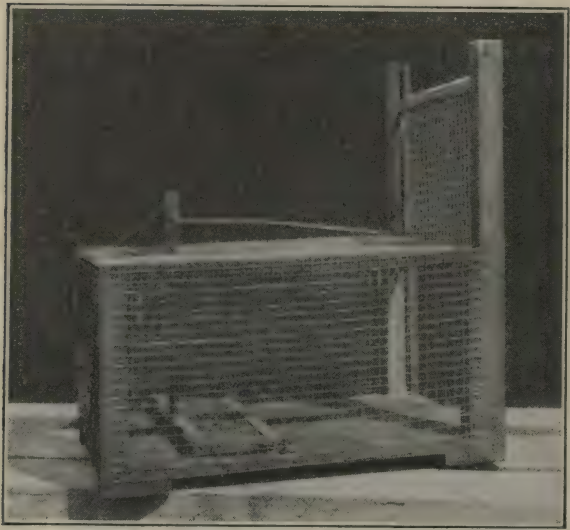
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FIGURE 2.—Evans vermin trap. This trap is 14 inches high, 17 inches wide, and 24 inches long. The front standards are 27 inches tall and contain a slot three-eighths of an inch wide and five-eighths of an inch deep. The door measures 15 by 12 inches. Door and treadle (6 inches wide) have the edges soldered in folded strips of heavy zinc. Mesh is five-eighths of an inch square heavily galvanized. All screws are brass, the spring phosphor-bronze, and the levers iron. The corner posts are tinned inside and the whole trap dipped in paint. The small triangle of tin on the far standard falls across the slot when the door is down and prevents it from being raised

TRAPPING[4]

Theoretically, a vermin-proof fence should make trapping unnecessary. Unfortunately such fences rarely are entirely proof against natural enemies, and, if so at first, seldom retain perfect effectiveness. Predators having once entered the game farm or subsidiary inclosure, it is necessary to combat them directly, and trapping is a favorite method. Traps are indispensable aids in controlling vermin, but their use is often turned to abuse. Care should be taken as to where and when they are set, and as to how long they remain set. A set trap is dangerous 24 hours a day every day, and will catch other creatures just as effectively as those particularly sought. It should not be placed, therefore, where it will be a menace to other than the offending animals. It should not remain set after danger has passed. While set, it should be inspected at least once daily so as to shorten the period of the captive's sufferings, and to release an innocent creature alive. This last consideration makes traps that catch their victims alive and uninjured preferable to traps that kill or that cripple when they do not kill. A decided advantage of such traps is that stray game birds getting into them can be restored to stock.

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[4] The limits of this bulletin prevent giving specific instructions for trapping various kinds of animals. These may be found in general works on the subject of trapping, a list of which may be had upon application to the Bureau of Biological Survey, U. S. Department of Agriculture. State laws relating to the protection of fur-bearing animals, many of which are on the game breeders' list of vermin, are digested in a farmers' bulletin that can be obtained from the U. S. Department of Agriculture.

TRAPS FOR GROUND ENEMIES

The Evans vermin trap illustrated in Figures 2 to 4 is ideal for ground enemies, since it can be built in any desired size and captures without injuring. Probably the best way of disposing of destructive animals caught in this trap is to shoot them with a small-caliber pistol, which can be carried in a pocket without inconvenience. Harmless snakes, toads, frogs, rabbits, and other innocuous animals caught in this trap can be released alive if inspections are made daily, as they should be.

The Evans trap is very effective when set with the side close against a fence. (Fig. 4.) Sometimes a stake is placed against the outer frame of the door to hold the trap firmly against the fence and to support a short wing of wire netting flaring off to another stake to direct into the trap animals that might otherwise pass a few feet away. Sometimes the trap is set with the mouth against an opening in the fence, and so hooded over with wire netting that entrance into the trap is the only possible course. Ordinarily no bait is required, but should its use become desirable, it can be wired to the back wall of the trap.

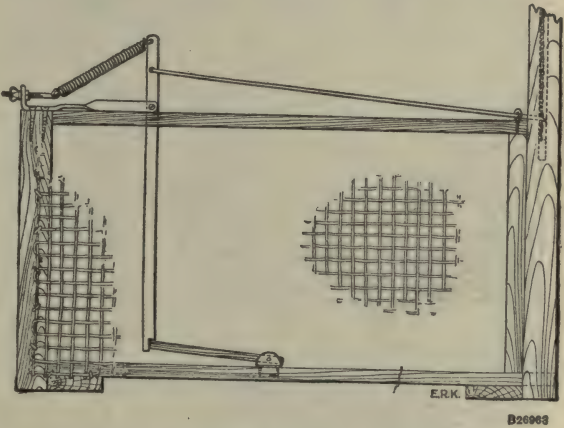

FIGURE 3.—Operating parts of Evans trap

Other traps capturing animals alive are illustrated in Figures 5 and 6. The Melbrook trap is framed with channel iron, covered with wire mesh, and provided with a door and treadle of heavy-gauge sheet iron; its strong construction, all of metal, is an advantage in preventing gnawing animals from getting out and in making the trap easy to clean. The Fooks trap (fig. 6), seen in Europe, is especially useful for setting along fences or in comparatively small spaces likely to be the runways of predators and is said to be most effective when covered with brush. It is a tunnel-like box about 40 inches long and 8 inches square and is always open at both ends and set except when it contains a captive. It contains two treadles, each approximately half as long as the box, which are covered with sheet metal to prevent rats from gnawing out. The remainder of the inner surface also can be lined with sheet metal or wire mesh if it is found to be necessary. The treadles are thin at the outer end and fit snugly against the floor in the set position. They pivot at about the middle, and an animal passing this point tips them up at the outer end, which remains raised because of a wire wicket slung underneath, which catches on the floor and prevents the outer end of the treadle from coming down and which in the fully vertical position holds the treadle firmly up against the top of the entrance. The treadle occupying the other half of the trap operates instantly as the captive passes the middle. A door on top at the middle gives opportunity for inspection through the netting roof or lining.

In certain cases it is necessary to vary the method of trapping, and then ordinary steel traps can be used. These are probably the best devices for use against rats[5] under buildings and other structures. Great care must be taken, however, to set these traps where game birds can not get into them. In burrows under objects and in holes where the birds can not go the trap may be set without special protection. Elsewhere it may be put under a box with a notch cut in the edge, under a troughlike shelter made of three boards, or under a cover improvised from wire netting; in each case, however, the entrance to the trap should be so small that the birds can not get in.

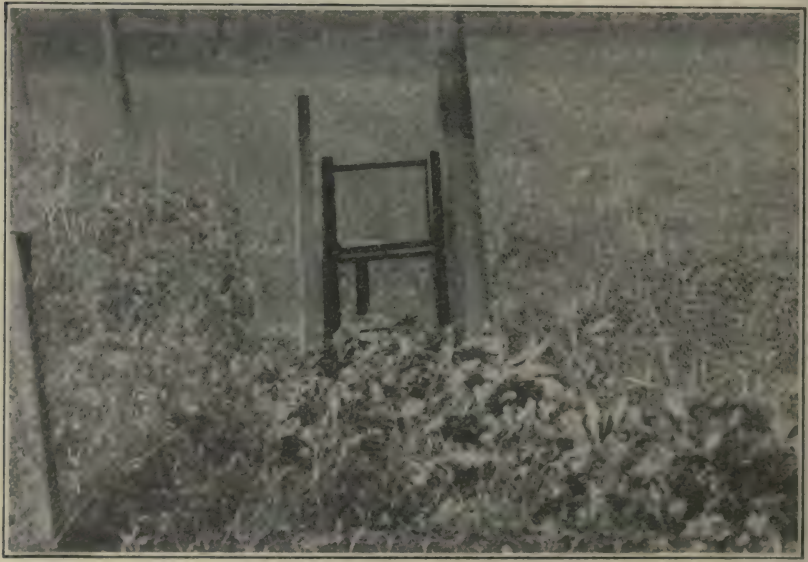

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FIGURE 4.—Evans trap set along fence

All such sets are best made along fences where ground enemies are prone to run. Ground traps of all kinds should be kept out of rearing fields where there are small game birds.

TRAPS FOR BIRDS OF PREY

Winged enemies also have been combated chiefly by use of traps. The most common device is an ordinary steel or jump trap set on the flat top of a post or pole and fastened to it by the chain of the trap. These traps instantly kill small birds getting into them and usually are the cause of lingering death to larger species, which in their struggles fall with the trap from the top of the pole and hang head down until death ensues. Birds that do retain their perch on the top of the pole usually have one or both legs injured so that it is

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[5] Full information on the control of rats is contained in the following publication: SILVER, J. RAT CONTROL. U. S. Dept. Agr. Farmers' Bul. 1533, 21 p., illus. 1927.

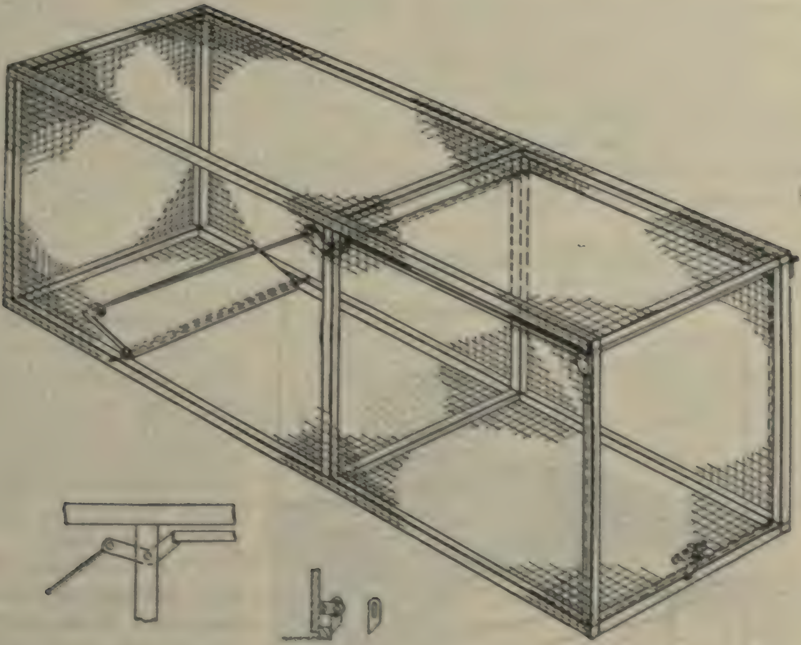

FIGURE 5.—Melbrook trap in set position: the door (under near half of top) falls when the treadle is depressed, releasing the trigger shown in separate outline drawing, and has a sliding bolt that catches on frame and holds the door closed

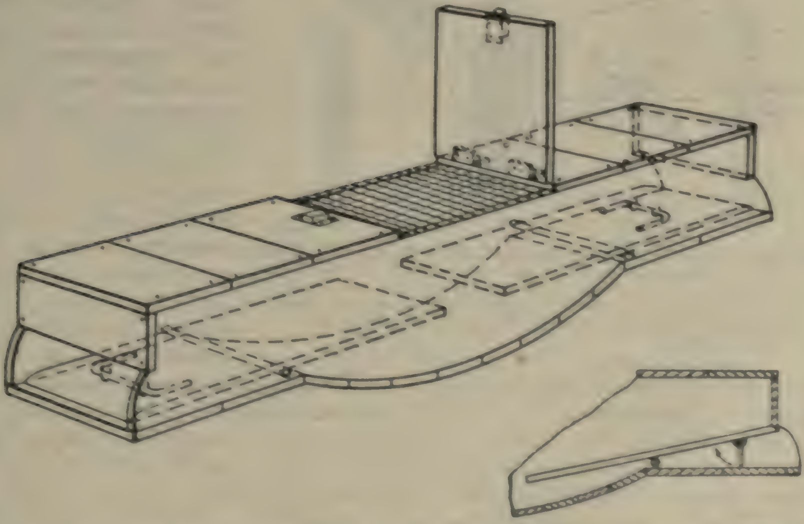

FIGURE 6.—Feeks trap. The middle section of the bottom need not be round but can be broadly V-shaped

necessary to kill them. These troubles can be obviated in part by having the chain of the trap attached to a large ring around the pole, or a smaller one on a wire, that will slide to the ground when the trap is moved from the top. This permits the release alive of any useful bird that has not been crippled by the first grip of the trap.

As ordinarily used, pole traps are objectionable in several respects. Not only should the number be reduced to the minimum, but also the objectionable features of those kept in use should be lessened. Breaking the legs of larger birds can be prevented by wrapping the jaws of the trap near the ends with hard cord of sufficient diameter to keep the jaws well separated when sprung. This will hold the larger birds but will permit the escape of such smaller ones as are not disabled or killed when struck by the jaws of the trap.

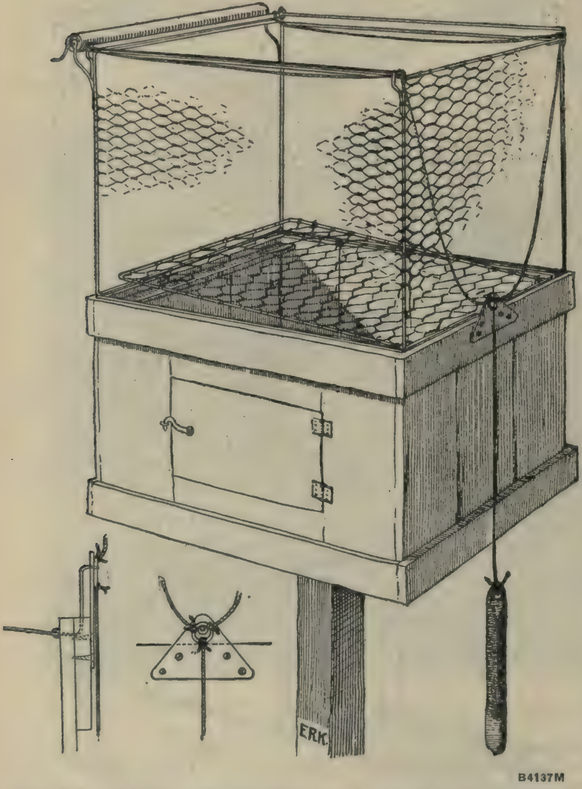

FIGURE 7.—Basket trap for hawks. A live chicken or pigeon is kept in the lower part of the trap for bait. A hawk endeavoring to strike the fowl depresses the wire-netting floor of the upper part of the trap, releasing the weight, which pulls over the top of the trap the rolled curtain shown at the left

The indiscriminate killing of various small birds is the greatest fault of pole traps. If the traps are set at all times, a number of small birds will be killed to every hawk captured. It is a painful experience to make the rounds of a game farm and find flickers, red-headed woodpeckers, kingbirds, and bluebirds dead in the pole traps. Such destruction of innocent birds not only constitutes unnecessary cruelty but is also wasteful of these useful bird lives and in most cases is a violation of Federal or State law. The killing of small birds by pole traps can be obviated, in part, by setting traps too heavy for such birds to spring them. Another device is to put a pad of cotton under the pan that will compress under the weight of a larger but not under that of a smaller bird. Both legal and humanitarian considerations require that the use of pole traps be carefully regulated. If moderation in using them is not observed, legislation entirely forbidding their use may be expected.[6]

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[6] They are now outlawed in New Jersey.

Devices that make it possible greatly to reduce the number of pole traps and at the same time to retain the effectiveness of those used against predatory birds are (1) tapering the tops of most of the fence posts to a point, and (2) guarding flat-topped posts by inserting in each an erect, slender wire to prevent large birds from perching upon them. If all the ordinary fence posts are so treated and only selected posts or poles provided with traps, the large birds will be driven to the latter when they seek to alight. Some hawks habitually perch to watch for prey, and while these are the species least destructive to birds, they are the very ones that are most frequently caught in pole traps. The bold, dashing bird hawks are more apt to come skimming over the tops of fences and pounce without a pause upon the first victim that offers.

Because of their selective destruction of the less harmful hawks, and of their danger to bird life in general, pole traps should be abolished as rapidly as practicable. Traps that capture birds alive should be substituted for them, so that harmless species can be released. Suggestions for such a trap are given in Figure 7. A cage with live hawks or owls in it attracts other birds of these kinds, and may be placed near a pole or basket trap to decoy such visitors to the farm.

SHOOTING AND OTHER METHODS

Patrolling the game farm by an armed man with a well-trained dog is probably as satisfactory a method for the control of diurnal enemies as can be had. This conclusion rests on the supposition, however, that the man knows his business and does not blaze away at everything alive on the place except the game birds. The man can be and should be selective in his war on predators. His presence, together with an occasional shot from his gun, should have a strongly deterrent effect on the visits of winged enemies, and his watchfulness and activity should strictly limit depredations by ground vermin. More crows and hawks can be killed by using an owl decoy and by shooting from a blind or cover than by other methods. Crows also can be poisoned with eggs treated with strychnine, but these should be placed so that valuable animals can not get them.

Where patrolling is carried on, scarecrows (fig. 8) may have some value. When manlike figures are always stationary, birds become accustomed to them, but when there is also some patrol work, with moving about and shooting, the warning effect of the stationary figures is much greater.

The Clove Valley (N. Y.) Rod and Gun Club has found that it pays to keep a good stock of cottontail rabbits as a first line of defense against enemies on areas stocked with game birds. Foxes, weasels, and certain other predators seem to prefer the rabbits or find them easier to catch; accordingly rabbits are imported into the preserve every year.

SHIPPING UPLAND GAME BIRDS

Troubles in shipping game birds, varying from minor mishaps to disasters, some of which might not even be imagined by the novice, have been encountered from time to time, and for the most part are guarded against by experienced breeders and dealers. Not only are losses of valuable birds likely to result from improper shipping methods, but the usefulness of birds as breeders, at least for the first season and sometimes longer, may be destroyed by terrifying experiences in transit.

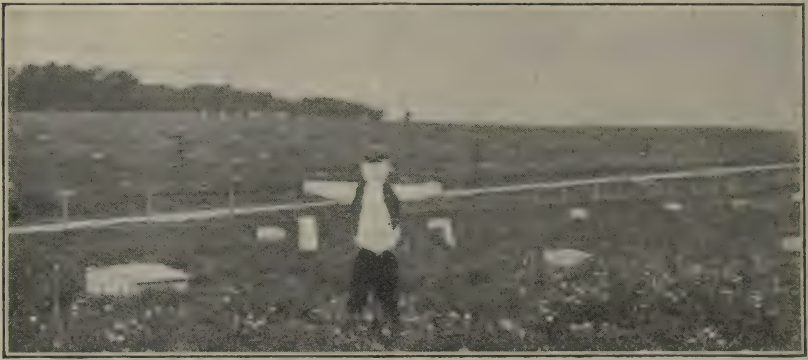
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FIGURE 8.—Scarecrow in rearing field. The inner support is a crosslike frame. An outer stake is inserted in head. Bright sheets of tin, so arranged as to turn with every breeze, are suspended from ends of arms

For shipping a few birds a short distance, nothing surpasses a roomy basket of the climax type. Such a container is light, and the prominent upstanding handle reduces the chances of its being thrown about and also prevents piling other objects on top of it. The basket can have holes to admit air and light, but these should be so small that the birds can not possibly stick their heads through. The top should be close-fitting and firmly fastened. These baskets can be had in various sizes, from which selection can be made according to the size and number of birds to be shipped.

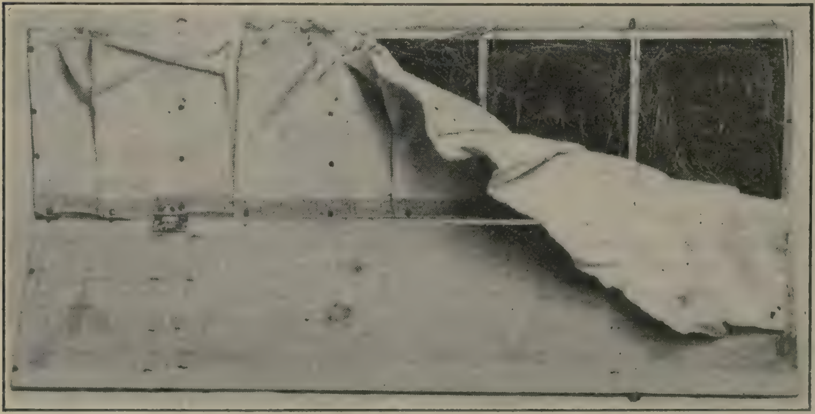
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FIGURE 9.—Shipping box for day-old chicks. Dimensions: 28 by 7 by 4½ inches. The flannelette is tacked down and screw eyes are wired together before shipment

Young birds are commonly shipped in the basket type of container, but on some game farms that feature the distribution of day-old chicks special shipping boxes (fig. 9) are provided. These are long, flat boxes containing a series of compartments, in each of which 10 baby pheasants are snugly packed in a thick nest of soft hay and covered with flannelette, which is tacked down all around the edges and to the partitions between compartments so that the youngsters can not get out. These containers are shipped any distance that can be covered by ordinary or air mail in 48 hours, and are accompanied by directions for turning them over to broody hens immediately upon receipt and for feeding them. Broody hens and food also are shipped along with the young to customers desiring this service.

A type of container convenient for ordinary shipments of upland game birds is illustrated in Figure 10. This approximates the regulation crate used for importations of Mexican quail, the specifications for which are as follows:

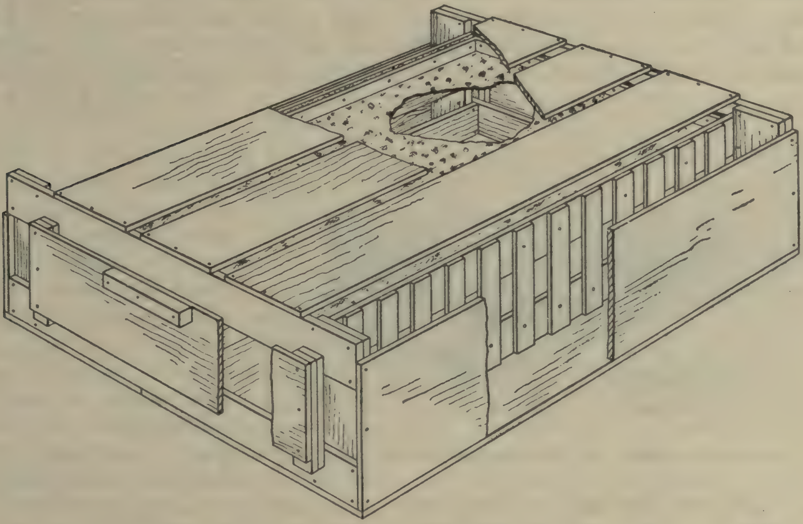

FIGURE 10.—Light shipping crate for upland game birds. Spaces between boards and special ventilators at ends provide for ample circulation of air. Front food trough accessible through stanchions is for grain or mash; back one, reached through longitudinal slot (seen through opening represented in top fender), is for lettuce and the like and for a water container if one is provided

Each crate shall have a false top of stout cloth or burlap stretched taut and smooth, so as to leave a space not less than 1½ inches between the cloth and the top of the box, and shall be provided with a handle at each end. Crates must measure inside not less than 6 inches in height (from floor to false top) and have approximately 20 square inches of floor space for each bird. Not more than 24 quail shall be placed in a single small crate or compartment, and not more than 48 in a double crate with a partition separating the two compartments. The feeding compartment must project 3 inches or more to prevent crates from being stacked close together, thus cutting off ventilation. Quarter-inch intervals must be left between the boards forming main body and half-inch intervals between the slats forming the top of the crate to provide ventilation.[7]

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[7] UNITED STATES DEPARTMENT OF AGRICULTURE, BUREAU OF BIOLOGICAL SURVEY. REGULATIONS FOR THE ISSUANCE OF PERMITS FOR BOBWHITE QUAIL IMPORTED INTO THE UNITED STATES FROM MEXICO. U. S. Dept. Agr., Bur. Biol. Survey Service and Regulatory Announcement 69, 2 p. 1927.

The essentials of such crates are light construction, projecting food hoppers, the false top or fender, and ample ventilation. Dimensions can be varied to suit the kind and number of birds shipped, but it is well to remember that overcrowding should be avoided; best results are obtained with only a moderate number of birds to each container. Somewhat stauncher construction may be obtained by substituting for the end-ventilating device a board that will be flush with the remainder of the wall. This may be prepared as a sliding section by adding upright cleats across the end boards at each side, thus making a convenient place for putting birds into the crate and taking them out. It should be fastened with screws.

A crate suitable for shipping a considerable number of birds a moderate distance when it is desired to send them in one lot, as for exhibition purposes, is illustrated in Figure 11. This crate is 5 feet long, 27 inches wide, and 14 inches high. The ventilating crack extending all around is seven-eighths of an inch wide. The sliding panel in front, when closed, is screwed into position to prevent tampering with the birds.

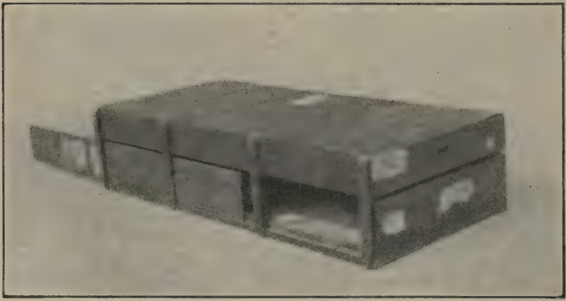
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FIGURE 11.—Crate for shipping upland game birds

In the case of birds caught wild for introduction into another continent, the care of freshly captured specimens is of importance. Handle them as gently as possible at all times, especially avoiding compression of the body, pulling of feathers, or holding the birds by the legs, which may be broken by a sudden effort to escape. As soon as practicable place them in a darkened room or case, with only a little opening near the floor to give light near which the food should be placed. If only a room or other spacious inclosure is available, the quill feathers of one wing should be cut off to prevent the birds from dashing against the walls, or brails may be applied. (See p. 20.) A low perch may be provided for tree-frequenting species. When the birds are ready to ship, preferably after they have become somewhat accustomed to confinement, place each individual of large or mixed species in a separate crate or compartment. Several partridges and similar small species can be put together. A single door at the back will serve for putting the birds in, and it may be nailed shut for safety during shipment.

Whatever sort of shipping container is adopted or improvised, a few general principles should be observed. The container should be so built that it will have a definite and easily recognized top side, or even so that it can not possibly be set on that side, in order to minimize the risk of overturning. Also the top should be distinctly marked "Handle with care," "Do not delay," "Live birds; rush," "Keep in a cool dry place," or with similar conspicuous signs giving essential directions. Light should be admitted to the container, but there should be no holes through which the birds can put their heads and no openings about the lower sides or bottom through which their feet might slip. The inside should be high enough to permit the birds to stand fully erect. Slatted coops or boxes with wide cracks can be lined with cheesecloth, and wire netting should never be used without cloth guarding to prevent the birds from injuring their heads. All nails should be well clinched. A good layer of shavings, leaves, straw, or other absorbent material should be provided on the bottom, and on long trips changed every few days. The top of the container should be provided with a fender of tightly stretched fabric an inch or more beneath the wood, or it should be padded with excelsior, straw, or the like under cheesecloth or burlap.

Unless it is unavoidable, expressmen and others should not be depended upon for feeding and watering the birds, for they may fail to do it or may give them something that will be injurious. For a 24-hour trip food and water can be dispensed with, but for trips of moderate length food hoppers should be fastened firmly to the inside of the cage and charged with enough of the birds' ordinary rations and grit for the trip. A leading reason for the commonly successful shipment of quail and partridges is that it is easy to supply small grain and mixed seeds, which are a good substitute for their natural food. Birds more exacting in their requirements, or more delicate or valuable birds, should have special foods both animal and vegetable, approaching their natural preference as closely as may be. Bulky foods of less nutritive value always are preferred to concentrated ones. Hence if dried wild fruits can be obtained, they will form a valuable variant of the diet; possibly raisins or pine nuts can be sparingly substituted. Green foods are always desirable for their own sake and as a substitute for water; heads of lettuce or halves of apples, beets, turnips, carrots, or the like, which are useful in the same way, may be fastened to the ceiling where they will remain clean.

In the case of birds shipped without a caretaker, advance notice of shipment and probable date of arrival should be given. Large lots of birds on an extended trip, or other especially valuable shipments, should have a caretaker traveling with them. Cages may be cleaned and exceptionally wild birds fed and watered through a low opening across the bottom of one of the walls. For more tractable birds it is convenient to have a feeding and watering tray projecting from the floor of one side of the container, access to which by the birds is through a narrow longitudinal slot or through openings between closely placed vertical pegs. Food should be varied, clean, frequently replenished, and remnants thoroughly cleaned up. Grit should not be forgotten. It is well to add a little disinfectant to water, such as a few drops of some saponified cresol solution, or one part of corrosive sublimate (mercuric chloride) to 4,000 parts of water. Avoid ice water. The water receptacle should be kept scrupulously clean. On board ship, when the weather is not cold, crates containing birds can advantageously be kept on deck, well sheltered from the wind, with canvas overhead to screen off direct sun or rain. In cold or unfavorable weather they must be taken below. Different species of birds or different sizes of young should not be mixed in the same crate, as the larger birds will fight and injure the smaller.

SHIPPING EGGS

Standard containers (fig. 12) for pheasant eggs are now available, and made-to-order shipping crates for eggs of other game birds no doubt can be had. These crates have molded paper forms closely fitting the eggs; for shipment in other types of containers, eggs should have individual wrappings. Some shippers wrap the eggs in two long strips of newspaper, one applied at right angles to the other; others twist them up tightly in wisps of hay. The outer packing for these individual eggs may be shavings, excelsior, hay, or similar shock-absorbing material. The best containers are baskets of the oblong grape-basket type or the round peach-basket type. (Fig. 13.) Both are light and suggest careful handling, and neither can be stacked with heavier objects.

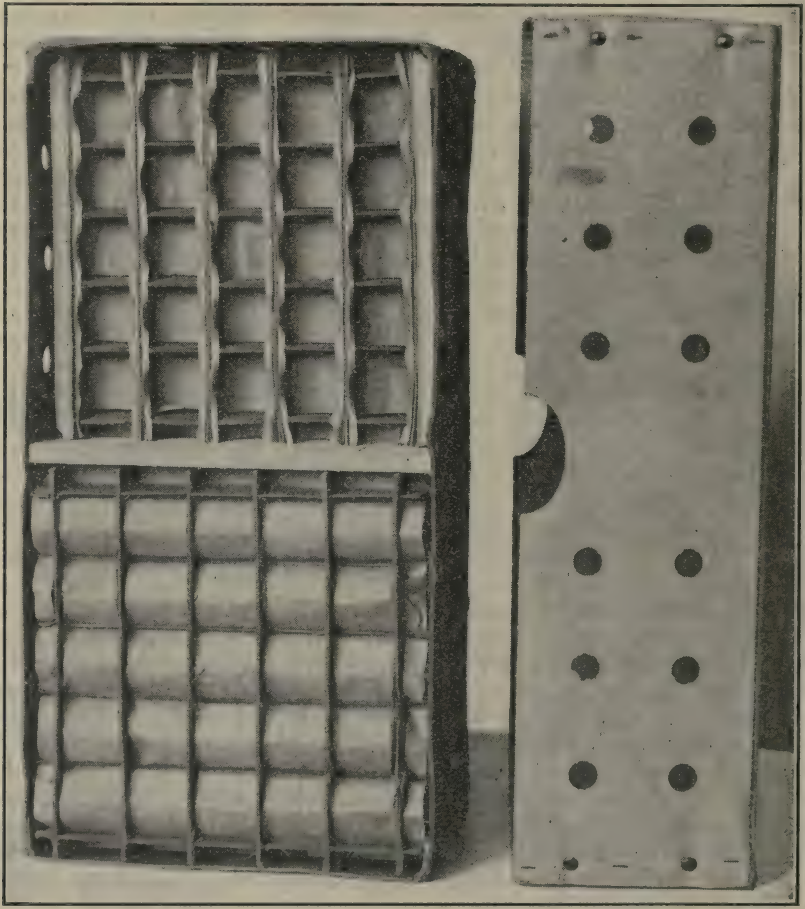

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FIGURE 12.—Standard container for shipping pheasant eggs

IMPROVING COVERTS FOR UPLAND GAME BIRDS

The favorite resorts of upland game fowl have long been known as coverts, no doubt on account of their being admirably adapted to cover or conceal the birds. Such coverts are usually characterized by an abundance of low but dense and stiff or thorny shrubbery, together with luxuriant growths of grasses and weeds. These plants supply also an important part of the food of the birds.

Bobwhites frequently use coverts of plum, rose, alder, bayberry, sumac, and blackberry bushes, and dense banks of honeysuckle. These plants furnish food for the birds, but they should be supplemented by others more exclusively adapted for the purpose. The quail is especially fond of mulberries in addition to those previously mentioned. Among valuable seed-bearing plants are Japanese clover, beggar lice, buckwheat, sorghum, broomcorn, kafir corn, millet, wheat, vetches, cowpeas, and any plants of the pea family producing small seeds. These are sown in large quantities in cultivated areas known as feed patches. The seeds of milk pea (Galactia), partridge pea (Chamaecrista), hog peanut (Falcata), wild bean (Strophostyles), and smartweeds (Polygonum) are important natural foods of the eastern quail, but their growth should be encouraged only where they will not become weed pests. Western quail are fond of the seeds of sumac, bur clover, alfilaria, lupines, napa thistle, and turkey mullein, but where these plants are likely to become nuisances the food species recommended for the eastern quail will serve. Some quite valuable kinds will volunteer in newly plowed land, so that merely turning the soil improves the area as a feeding place for quail. The Hungarian partridge, like the bobwhite, thrives in open country, where often the chief cover is furnished by growing crops, hedges, or brushy fence rows. Improved coverts for the bird may be made, however, by planting much as recommended for quail.

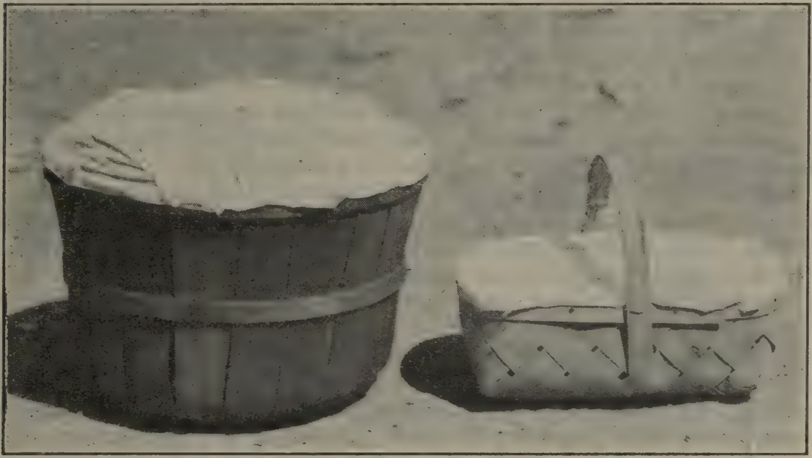

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FIGURE 13.—Baskets of pheasant eggs as packed for shipment

Coverts for grouse, as the sharp-tailed, should abound in such plants as rose, sumac, blueberry, bearberry, buffaloberry, snowberry, dwarf birch, and alder. The ruffed grouse thrives among scrub oak, bayberry, rose, sumac, dwarf birch, alder, poplar, willow, and such fruit-bearing plants as partridgeberry, hawthorn, shrubby dogwoods, viburnum, wild grape, mountain-ash, blueberry, blackberry, and cranberry. Cover of this nature is suited to pheasants also, but it is well to supplement the food supply furnished by these shrubs and trees by planting small grains and legumes as recommended for quail. None of these game birds should be released in dense woodland. Brushy ravines, overgrown pastures, or other waste land about farms are much better. Recommendations as to specific kinds of fruit-bearing shrubs attractive to birds and adapted to various parts of the United States are contained in Farmers' Bulletins of the Department of Agriculture, which can be had free upon application.

LIBERATING GAME BIRDS IN COVERTS

Game birds should not be released in coverts until everything possible has been done to improve food conditions and to free the place from the more destructive natural enemies. The great object in liberating game birds is to do it in such way that they will tend to become localized. If the time chosen is near evening the birds will not have time to wander far before roosting. Put down the shipping container near natural or felled brush cover, scatter suitable food about it, open only enough for the birds to creep out gradually, and promptly leave the scene. When returning to the spot for the basket or coop or for feeding, which should be kept up regularly until the birds are established, approach cautiously, and keep dogs and other animals away from the spot as much as possible.

The foregoing directions apply to liberation of the usual run of purchased or allotted birds, whether immature or adult. Best results are had from stocking with adults in the spring, but there are improved methods of liberating young birds that are much better than simply freeing them and trusting to luck. Some dealers ship broods of young game birds each with a foster parent, and these families are cared for in the covert as they would be in a rearing field. This method protects the young against starvation, and to a degree against enemies. Gradually the young will desert the hen and shift for themselves, and it has been observed that they are also tolled away and adopted by wild adults of their own species. It has also been found practicable with quail and Hungarian partridges to liberate broods of young in the care of surplus or wild-caught cocks of their own kind, to which the chicks have been accustomed at an early age. Wild cocks are caught in a trap similar to that illustrated in Figure 29, with the addition of a central compartment in which a hen is confined as an attraction. About a dozen chicks are sufficient for one cock.

The introduction cage with prospective foster parent in it can be placed near the coop containing hen and young birds, the latter being allowed to drift over to the adult of their own species, which is usually eager to adopt them, or chicks can be placed directly in a small darkened coop with the surplus cock, events being watched long enough to determine whether the young will be hovered; in the rare event that they are not, they will have to be returned to the hen or brooder for thorough warming before being tried again with another cock. The birds are fed as usual and are released with great care when from 4 to 7 days old. Broods liberated in the care of a wild cock will need neither shelter nor feeding, but in the case of pen-raised cocks, it will probably be better to supply both so long as they continue to be used.

PRIMARY STOCK

The United States Department of Agriculture has no game birds or their eggs at its disposal, and notwithstanding press notices to the contrary never has distributed any of them. Some of the State game departments from time to time distribute certain game birds or their eggs, but the regular sources of supply are game farms and commercial dealers. Addresses of these can be obtained from the Bureau of Biological Survey, United States Department of Agriculture, Washington, D. C.

It is more economical, as well as desirable in other respects, to start with adult birds purchased late in the fall, for these will then be well settled in their new home before the breeding season, and the owner will have learned something about handling them before the busy and critical laying and hatching season arrives. Releasing the birds in pens should be done in the same manner as described for loosing in coverts (p. 18). In the case of penned stock, the flight feathers of one wing should always be clipped before the birds are released.

To obtain initial stock from the wild, it is necessary in most cases to have authority for capturing the birds from State game departments. (See paragraph on Licenses, p. 1.) Beginning with wild stock involves delays while the birds are becoming accustomed to restraint, which can be avoided by using propagated stock.

WING CLIPPING, PINIONING, AND BRAILING

The clipping of the primary feathers of one wing is sufficient to keep birds under the degree of control necessary on game farms and is the usual method. Many establishments, including some of the largest, never brail or pinion a bird. Pinioning especially is infrequently applied to upland game birds except fancy pheasants or specimen birds that are never to be released. As the extensively propagated species are kept for breeding only two or three years and then released, none of them are ever pinioned.

WING CLIPPING

Wing clipping is simply the shearing off of the principal flight feathers, or primaries, well away from the flesh of the wing, and it is necessary to repeat the process on adult birds at least annually after the regular molt in midsummer. Young birds must be wing clipped about every two weeks from the time they begin to fly until the adult plumage is attained. When for any reason birds capable of flight are desired, it is only necessary to pull out the stumps of the clipped feathers; new ones will come in at once and be fully grown in three to four weeks.

PINIONING

Pinioning means cutting off the last section (the fingers) of the wing to which the long flight feathers are attached.

To pinion an adult bird, raise the thumb of the wing (at base of last joint) and tie a cord tightly around the last joint well up under the thumb. (Fig. 14.) Have ready some tannic acid in powdered form. With a pair of strong, sharp scissors clip off the joint close below the cord, removing all or nearly all of the long flight feathers or primary quills. At once take a pinch of tannic acid and press it firmly into the wound to check bleeding. Glycerite of tannic acid (liquid tannic acid, 1 part; glycerine, 4 parts) also is used for the purpose. This seals the wound and gives good results. The cord should be removed a few days later when the wound is healing. Pinioning should never be done shortly before the breeding season. If full-winged birds must be rendered flightless at this time, merely clip the primaries of one wing. Pinioning chicks is very simple. Operate when the birds are 4 to 7 days old, if in good condition, snipping off the last joint of the wing and dipping the stump into tannic acid. Bear in mind that a pinioned bird never can fly; so if flight is likely to be desired at any time, it it better to continue the clipping of flight feathers.

Only one wing should be pinioned or clipped.

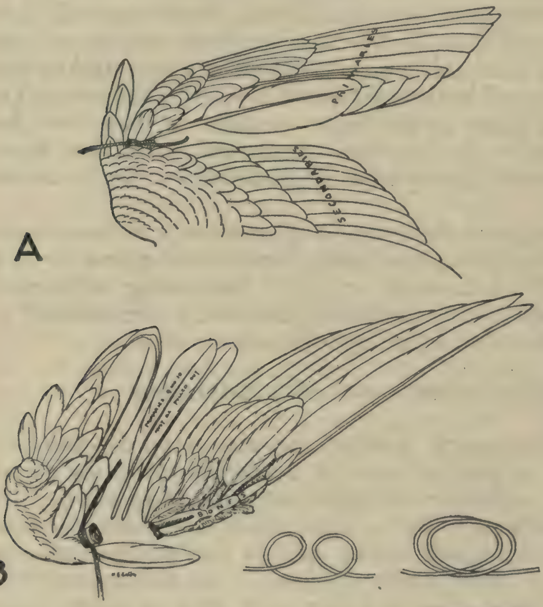

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FIGURE 14.—Method of pinioning. *A*, Upper side of wing showing flight feathers separated from secondaries, and tied just within point of amputation; *B*, Underside showing place of amputation and form of knot used

BRAILING

Brailing is tying the wing of a bird so as to prevent flight. It is for temporary use only, on birds being reared for liberation full winged, and in special cases when deemed advisable. There are various methods of brailing, two of which are here illustrated and described. Soft cord or preferably loosely woven tape is used. In method No. 1 (fig. 15) two pieces of equal lengths are taken and two knots tied so as to form a central loop with loose ends. This loop must be of a size proportionate to the wing of the bird being brailed; that is, it should slip easily over the elbow of the wing and fit snugly enough to hold it in the closed position. The loose ends underneath the wing are brought up over the top and tied in a square knot to the other set. In method No. 2 (fig. 16) a loop with one end of moderate length, the other much longer, is tied snugly, but not tightly, around the upper joint of the wing. The loose ends are tied in another knot, which should fall on about the middle of the upper surface of the wing; the long end is then passed between the bases of the second and third primaries or flight feathers, across the under surface of the wing, put through the loop on the underside of the upper joint, brought back over the side of the wing to the top, and tied to the short end with a square knot.

When properly brailed the wildest bird can be allowed its liberty in an uncovered inclosure, and not being able to expand the wing it is incapable of flight. Brails must not be left in place for extended periods, as stiff wings may result. This can be obviated by allowing the bird free use of the wings alternately for short periods.

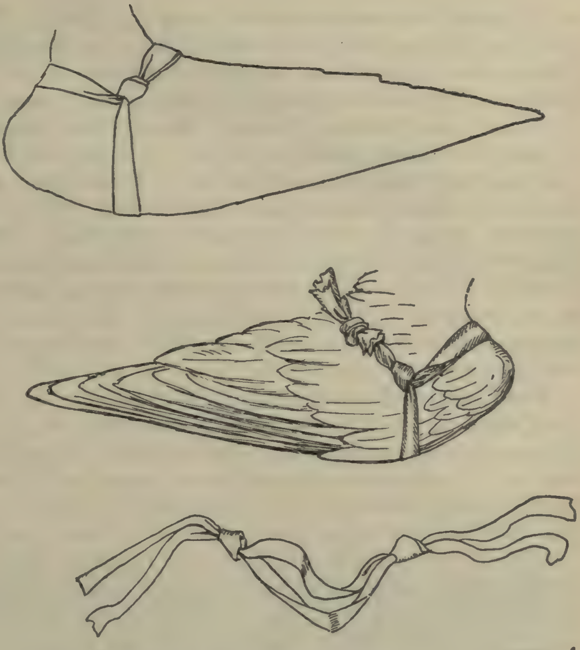

FIGURE 15.—Brailing; method No. 1

Only one wing should be brailed.

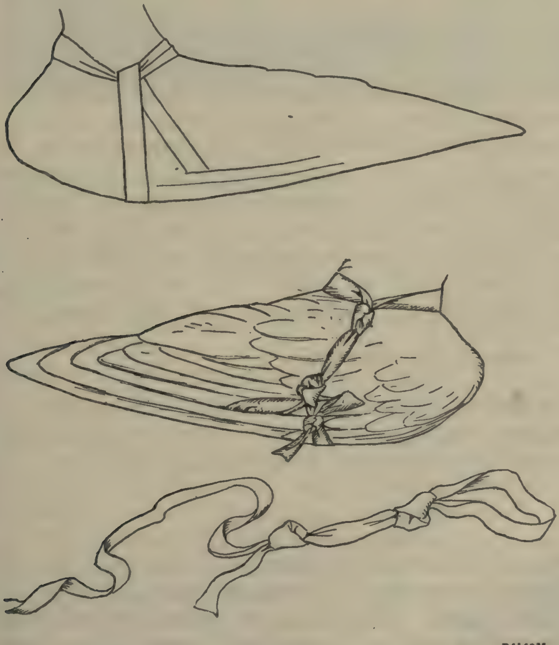

FIGURE 16.—Brailing; method No. 2

RING-NECKED PHEASANTS

ORIGIN AND DISTRIBUTION

More pheasants than any other kind of game bird are raised by man, and probably nine-tenths or more of the total number of pheasants reared in this country are ringnecks. Earlier importations and rearing operations in the Eastern States centered about the English ringneck, a hybrid developed in England between the common or black-necked pheasant and the Chinese pheasant. It is said that the Japanese pheasant also was freely crossed with the English hybrid. There are some pure blacknecks in the country, and this race no doubt has been released in stocking operations. Some Mongolian pheasants, another ringnecked race, also have been used. In the Northwestern States, where pheasant-stocking operations have been successful, the Chinese ringneck has been used almost exclusively; this variety has been distributed in large numbers also by the New York State game farms. An individual pheasant from coverts in the United States is likely, therefore, to be of hybrid breeding but is fairly certain also to have a preponderance of Chinese blood. All the birds mentioned in this paragraph are subspecific varieties, or geographic races, of a single wide-ranging species.

The hybrid ringneck has a variety of qualifications that fit it for propagating and restocking operations. It is polygamous and prolific and, while sufficiently controllable to be a success on game farms, retains its wariness and wildness so as to be well able to take care of itself when released. It is considered a hardier and gamier bird and has not lost maternal instincts to the same extent as has the English ringneck—an important point in relation to the increase of planted birds. Cold weather does not seem to hurt the ringneck; in fact, the bird has thrived best in the northernmost States. Numerous other pheasants have been hand reared and even used for stocking purposes, but for various reasons, as lack of hardiness, inadaptability to large-scale rearing methods, wildness, or sterility in captivity, none has proved worthy of comparison for general purposes with the ringneck. For an account of these pheasants, see the section on aviary or fancy pheasants, pages 46–48.

REARING EQUIPMENT

As previously mentioned, the use of ground free from the germs of disease and the renovation of fouled ground before reuse are controlling factors in systems of pheasant rearing. Though differing in details, all systems are adapted to meet these hygienic requirements. No one uses really permanent pens for pheasant rearing, for sooner or later new or thoroughly renovated ground must be had. So instead of speaking of temporary and permanent pens as distinctive of two types of rearing equipment and two schools of rearing methods, it is more accurate to refer to the small-pen and the large-pen systems.

SMALL-PEN SYSTEM

The keynote of the small-pen method of rearing pheasants is mobility. Not only are pens movable but they actually are moved at regular intervals to plots of fresh, uncontaminated sod.

BREEDING PEN

Within limits the size of the breeding pen can be regulated by the dimensions of available material. A common size is 12 by 16 feet on the ground and 7 feet high. (Fig. 17.) At the bottom of each wall are two boards, each a foot wide. These solid lower sides of the cages are important in preventing annoyance to the birds by dogs or other animals running about, and except for expense and weight could well be higher. At a slight additional expense the owner of only a few of these pens can improve them by making a higher screen of burlap or sheet roofing.

The lower board on the long sides projects a foot at each end and is rounded off like a sled runner, and in it is a hole for inserting a lifting or pulling device. The lower board on each of the short sides is hinged to swing outward. When these are lifted the cage can be slid over the ground without damage; the swinging boards also permit the transfer of the birds to an adjacent cage with little disturbance.

A few hints on moving methods may be of value. Horses can be attached to the runnerlike sides, but this method is more apt to result in damage to the pen than is hand moving. For the latter purpose large, strong, iron hooks with comfortable crosswise handles greatly facilitate a combined lifting and dragging movement by men. By dragging them slowly the pens can be moved short distances with the birds in them. When they are to be moved farther the birds should be placed in a small coop, and it saves wear and tear on the breeding pens to carry them on the platform body of a low wagon or truck.

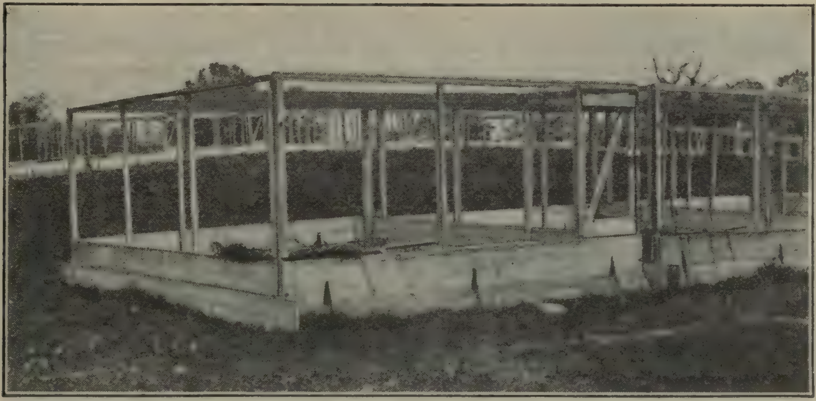

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FIGURE 17.—Pheasant breeding pen

Some foresight must be used when placing the pens to allow for regular moving to fresh ground. Two systems each bringing the pen on four different plots of grass in three moves are illustrated in Figure 18. With this number of moves the pen stays in one place from 10 days to two weeks. For weekly moving, nearly twice as many units of land would have to be provided, and this can be more easily done by the solid row arrangement and longitudinal moving system shown in Figure 18, B.

Details of construction of a breeding pen are shown in Figure 17. The uprights are of material 2 inches square, and the corners are reinforced by ⅞-inch slats nailed over the netting. Two bolts are placed through the framework at each corner and a short brace across each corner at the top of the boarding. The door is large enough for a man to enter. The netting throughout is ordinary 2-inch-mesh chicken wire. Along the side of the cage the uprights are clear of the ground, as shown in Figure 19, and those on the front and back do not extend below the upper board, arrangements that make it easier to slide the pen over the ground.

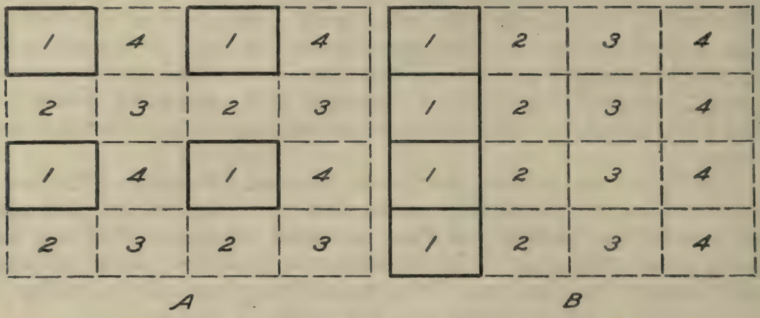

FIGURE 18.—Systems of moving pheasant pens

Some breeders provide a shelter by adding a board projecting inward from the lower part of the wall; this serves to keep a spot of ground dry where the birds can have a dust bath. Brush shelters under which the birds can hide and where the hens can resort for laying are essential; if they are attached to the pen as shown in the illustration they will cause no trouble in moving.

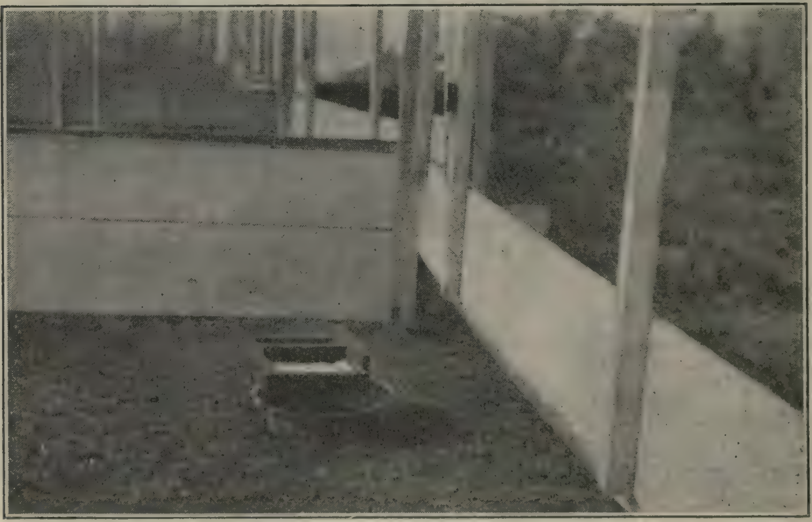

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FIGURE 19.—Neat combination of food, grit, and water containers

Receptacles for food, grit, and water should be standardized and durable; the combination shown in Figure 19, in which the food and grit box shades the water pan or crock, is a good one. It should be set near the door of the cage so that it can be emptied, cleaned, and refilled with the least disturbance to the birds. In hot weather, water must be replenished more often than food, so it is poured from a spouted can from outside the pen. One dash of water cleans and empties the pan, and a less violent pouring refills it. Breeding pens as well as all other inclosures for game birds should be so placed or constructed as to give the birds plenty of both sun and shade.

The function of the breeding pens is to house, protect, and keep the birds in such condition that there will be the maximum production of eggs. When the eggs begin to come in large numbers, other equipment is immediately needed. Methods of caring for the eggs until they are put under the hens are discussed on pages 35–36.

HATCHING COOPS

For convenience and economy, hatching coops are so planned that they can be used not only for housing the hens while they are incubating but also later when they are moved to the rearing fields to brood the young birds. The hatching coop illustrated in Figure 20 is 2 feet square, 23 inches high in front, and 12 inches at the back. The slatted door (1 foot high) is so constructed as to close, or, if slid to one side, to expose all openings between the slats forming the front of the coop. The closed position is normal for the hatching and the open for the rearing period. The slats are spaced so that the young pheasants can run freely in and out of the coop, but so as to confine the hen. When it is desired to release her the sliding door shown at the left of the picture is raised.

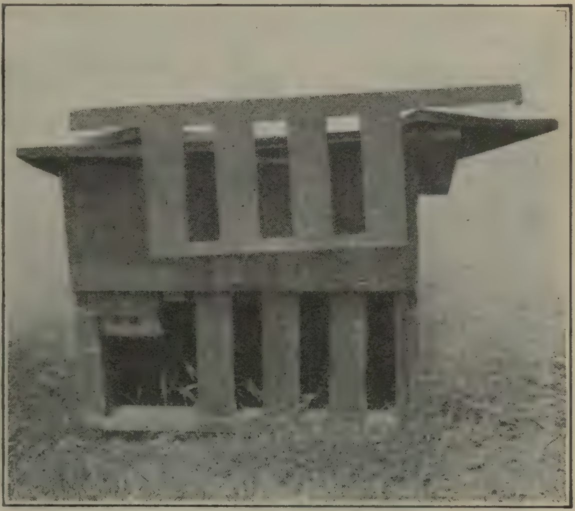

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FIGURE 20.—Hatching and brooding coop

The roof of the coop is 30 inches wide and 31 inches long and is provided with cleats on the lower side about 4 inches from each end that fit inside the walls of the coop and hold it in place. It should be made nearly or quite rain proof, with a covering of tarred paper or similar roofing if necessary. There is no floor. The coop is made of ⅞-inch material and may look clumsy and heavy, but there is good reason for this construction. Storms do not easily unroof or overturn the coops, and they stand wear and tear better. The roof should be weighted if necessary to prevent strong winds from blowing it off. The advantages of being rain and wind proof are obtained also by pyramidal construction of coops; or sometimes fibro-cement slabs are used for tops.

In the view showing the interior of the hatching coop (fig. 21) is the nest holder, a frame 5 or 6 inches high and 16 inches square. One of these frames is used to hold the nest in shape, and a second is placed on top of the other at hatching time to prevent the tiny young from scrambling away from the warmth and shelter of the hen, which are so necessary to them at first. The hole in the upper front of the coop shown in Figure 21 is for administering sprays.

EXERCISING RUNS

For convenience and economy of time the hatching coops are arranged in rows with space at the sides about equal to their own width, and sufficient in the other direction to allow for a path and to accommodate the exercising runs. (Fig. 22.) These runs are simple frames, 36 inches long, 27 inches wide, and 23 inches high, covered with chicken wire on top and with 1-inch-mesh netting on two sides and one end. The top is removable, and the drinking cup is attached to the frame. These runs fit the front of the hatching coops and provide a place where the hen can exercise, be fed and watered, or confined whenever it is desirable to exclude her from the hatching coop. Some pheasant farmers tether the hens to pegs in front of the hatching coops during their exercising period. This system involves more handling and does not give the hen so much freedom; its chief merit would appear to be economy in equipment.

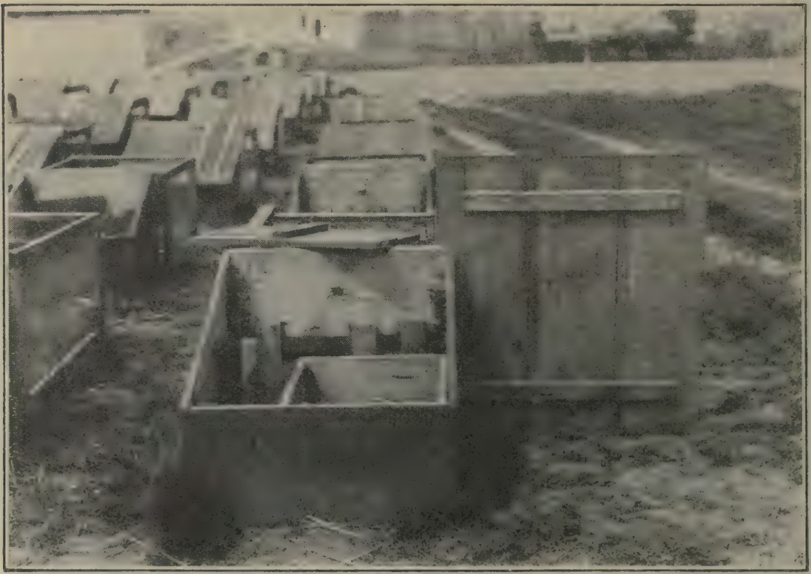
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FIGURE 21.—Interior of hatching coop

COMBINATION COOP

A combination hatching coop and exercising run is illustrated in Figures 23 and 24. The body of this is 30 inches square and is provided with two cleats on each side, so placed that a partition slid in them will divide the interior into two approximately equal compartments. The corner posts are 1½ inches square and the cleats of ⅞-inch and the walls of ½-inch material. The door on the side, 8 inches square, is hinged at the bottom and fastens with a button at the top.

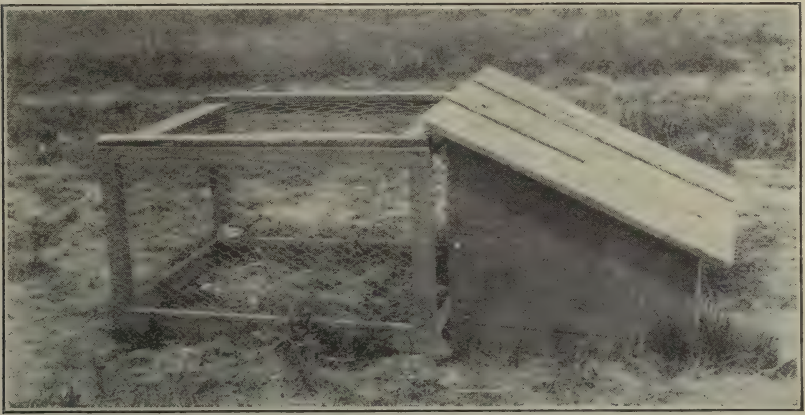
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FIGURE 22.—Hatching coop with exercising run

The front of the combination coop is of 1-inch mesh, with a 3-inch slat across the bottom hinged to open upward, thus providing a place for the chicks to pass through. The button mounted on the block at the left side (fig. 24) holds the slat in position when fully opened. The coop is 18 inches high in front, 20 inches at the middle, and 15 inches at the rear.

The roof overhangs all around, and the back section is hinged and strengthened beneath by three cleats cut so as to hold it firmly in place when closed, the upper two cleats fitting inside the body of the coop, and the lower one outside. The front half of the roof is provided with two blocks upon which the rear half rests when open. This prevents undue strain on the hinges and makes a level surface on which the caretaker may place anything he may wish to set down for a moment.

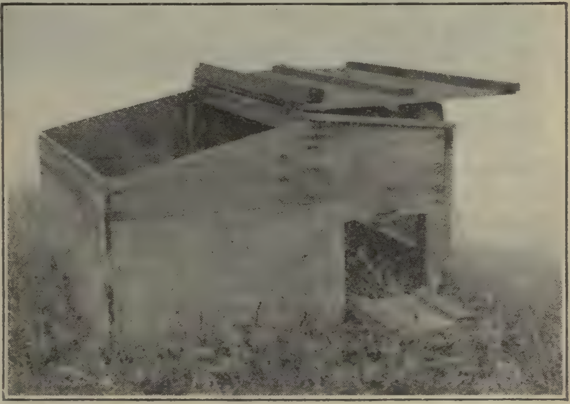
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FIGURE 23.—Combination hatching and brooding coop (side)

A convenient rearing coop and inclosed range seen abroad is illustrated in Figure 25. The run, about 6 feet long, 2 feet wide, and 2 feet high in front and 18 inches at the back, is covered with ½-inch or ¾-inch mesh, has no floor, and is hooked to the rearing coop proper of similar dimensions. The coop is one-third covered with a board and tar-paper roof, one-third with tar paper under the netting, and one-third with mesh only. There is a door at the end, and there are two on the low side with latches. The board-roofed section is partitioned off and has a sliding door in the inner end; this compartment has a floor of wire mesh (covered with soft hay), and the birds can be shut up in it at night perfectly safe from enemies. The remaining two-thirds of the rearing coop has no floor but is provided with a door shutting it off from the inclosed range. A hinged front in two sections gives facilities for varying shade and ventilation.

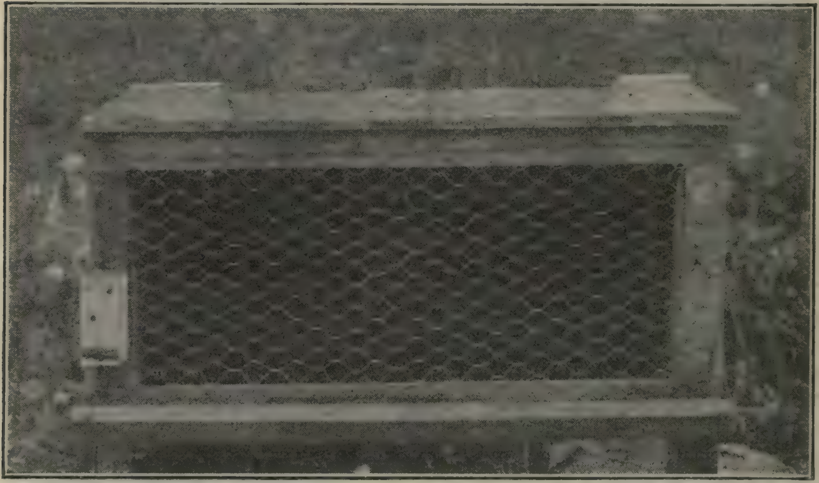

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FIGURE 24.—Combination hatching and brooding coop (front)

Breeding cages and hatching and rearing coops with their accessories are the principal items of material equipment for the pheasant breeder using the small-pen system. Besides these there are rearing fields and summer and winter ranges, which may be called environmental equipment.

REARING FIELD

So far as its vegetation is concerned, the preparation of a rearing field has been discussed under crop rotation (p. 2). Rearing fields should be on the higher or more rolling parts of the farm, well drained, and if possible with mellow, warm soil. The rank growth so desirable for the rearing field should consist partly but not entirely of clover, since a thick growth of clover alone holds too much moisture.

Shortly before the rearing field is needed for use single swaths should be cut in it from 50 to 100 feet apart. The hatching coops should be spaced 50 to 80 feet apart in the swaths, so as to allow for moving them 3 or 4 or more feet daily for 8 to 10 days.

(The illustration on the title-page of a rearing field in England shows stands of cover much narrower than the swaths, just the reverse of the usual practice in this country.)

The shorter grass in the swaths makes the work of the keepers in moving coops, watering, and feeding far easier and renders it less disagreeable on dewy mornings. The coops can be kept close to the uncut grass, so that the pheasants can easily reach it when taking cover. They will work all through it in their search for insects and small seeds. A little banking of soil around the coop is sometimes necessary to prevent water from draining into it. The coops should be placed on the rearing field a few days before needed, and in fine weather, so that the ground under them will be dry. When necessary, scratching by the hen can be discouraged by a covering of mesh over the bottom of the coop, or by setting the coop on a piece of burlap.

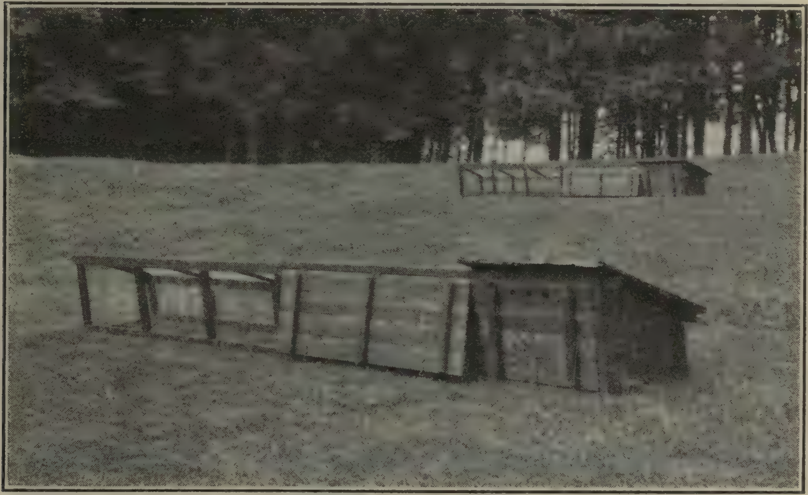

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FIGURE 25.—Rearing coop and inclosed range

LATE SUMMER RANGE

After the breeding season is over, it is desirable to have a fresh and ample range for birds that are to be held for the next season. These consist of about equal proportions of selected breeders of the current year and of two-thirds-grown young as they come from the rearing fields. Their late summer range should be land that has been prepared in much the same way as the rearing fields but from which more or less hay can be cut before the pheasants are put on it. It should be so managed, however, that when needed, several long strips across the field will have well-grown stands of millet, buckwheat, sunflowers, sorghum, or corn, which are valuable in providing both food and cover for the birds.

WINTER RANGE

Wooded rolling land with sheltered openings is ideal for winter range. (Fig. 26.) A few trees felled before the leaves have fallen or piles of evergreen brush will serve as refuges from winged enemies. In addition to plentiful ground feeding, which will encourage the birds to exercise, weatherproof food hoppers should be freely provided and kept filled. Patches of rape make an excellent supplement to the winter food. Arrangements for watering should be adjusted to weather conditions. A stream or pond on the winter range solves the watering problem, but in the absence of either, receptacles will have to be provided and kept free from ice as much as practicable.

Birds can be carried over the winter in more restricted quarters but at the price of increased labor. Windrows of brush or straw supported by wire-netting fences can be used as windbreaks, and all food can be scattered in deep straw so as to keep the birds working for their living. (Fig. 27.) All the straw, however, should be cleaned up and renewed weekly if not oftener. Clover hay not only aids in compelling the birds to rustle for their food, but is eaten itself, thus providing roughage.

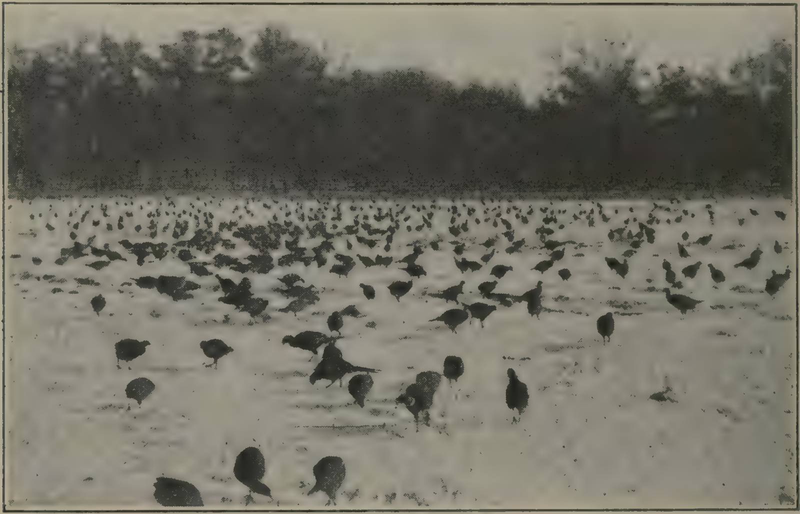

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FIGURE 26.—Open winter range for pheasants

LARGE-PEN SYSTEM

Under the large-pen system, the management of pheasants is practically the same as under the small-pen system, except in the matter of equipment. It is well to bear in mind in this case not to build too solidly or expensively. Shallow setting of posts, light stapling of wire netting, and the like will help when the inevitable moving time arrives, and it may come suddenly and unexpectedly.

BREEDING PENS

Breeding pens may be 200 by 400 feet or larger and contain 250 or more birds. The sides should be of 1-inch mesh and the top of poultry wire, but it is well to have 2 feet or more at the bottom made

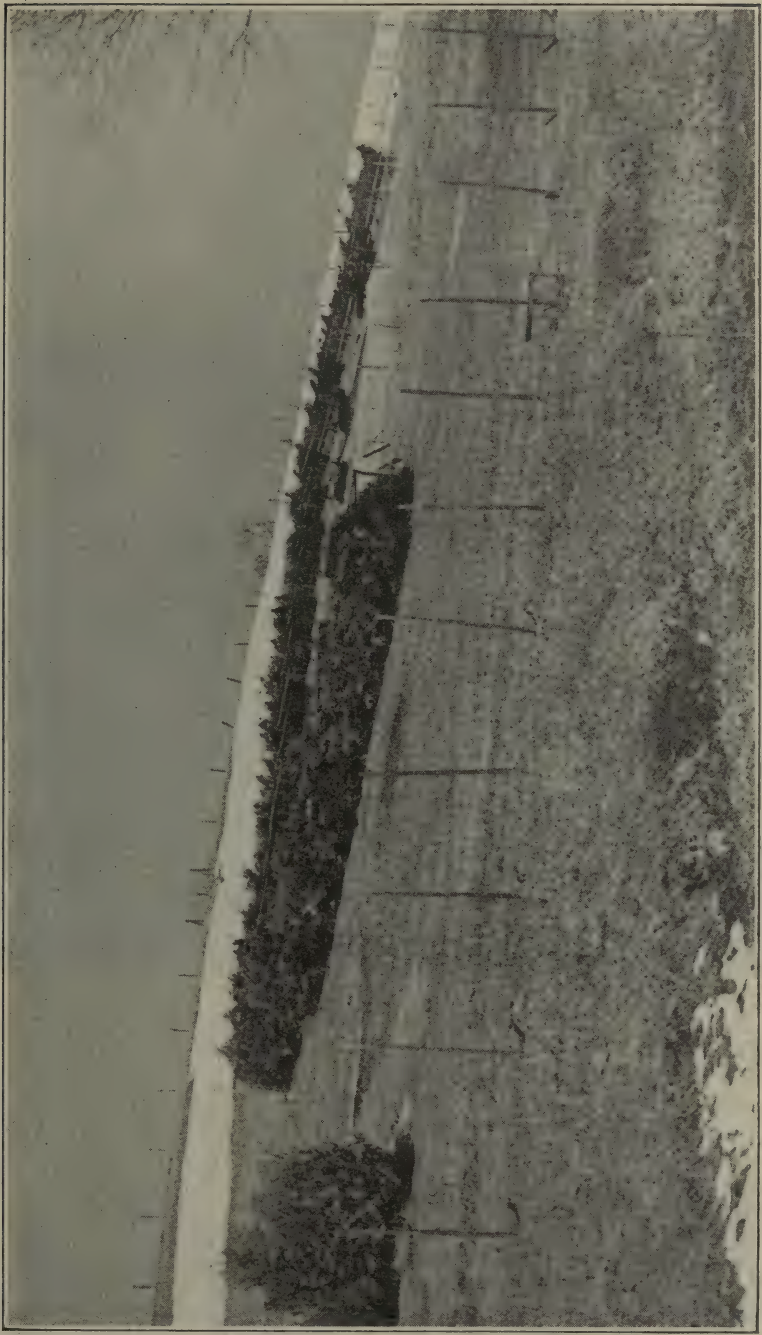

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FIGURE 27.—Concentrated winter range for pheasants

of boards (the lowest sunk in the ground) to provide shelter from winds, to exclude enemies, and to prevent dogs or other animals that prowl about the pen from annoying the birds. Where predators are especially troublesome the lowest course of the sidewalls can be of ½-inch-mesh wire netting extending 1 foot vertically into the ground and then outward 6 inches at right angles.

Shelter sheds (some of them built so that they can be used in trapping the birds) are usually provided along the side from which most severe weather can be expected, generally the north. The overhead netting must be staunchly supported to resist the weight of snow and sleet. In the case of uncovered yards, a section is partitioned off and roofed with netting to provide a place where the birds can be driven at night and be safe from enemies. The large breeding pens should have numerous piles of brush, under which the birds can take shelter, and ample food and water receptacles.

These large breeding pens are usually built in pairs, so that one can be spaded and limed or cultivated and planted for a season while the other is in use. Even so, the pens are moved to a new location after a few years.

Although much less expensive than small movable inclosures capable of housing the same number of birds, large breeding pens have certain objections urged against them. It is said that egg production does not average so high as in the smaller pens and that much more trouble is experienced because of fighting among the birds. Cocks are killed in fights during the early breeding season, and a less vigorous cock or a hen on which a wound is started during treading, if not removed, is soon worried and pecked to death by the others. Such occurrences are rare in the smaller breeding pens.

A system of pen building that retains some of the advantages of small pens while eliminating the labor involved in moving pens may be called the range system. As developed in the United States, the long sides of a range of pens are built much as suggested in the first paragraph on large breeding pens, and the interior is divided into small pens by easily removable mesh partitions. For ease of handling the partitions are made in sections of uniform size. One section in each partition must have a door, and it is well to align the doors throughout a range.

In England, ranges of pens are constructed by the use of hurdles, or sections of light picket fence. (Fig. 28.) The sections are 10 feet long and usually 6 feet 3 inches high. The slats are very close together on the lower 2 feet, or this portion is covered with tarred paper. The hurdles are supported by light posts put in holes punched with a crowbar and are lashed to the posts and to each other by short pieces of rope. The hurdles, half of which contain doors, are run in parallel rows, and across the rows run wire netting (lower 2 feet of 1-inch, remainder of 2-inch mesh) separating the pens, which are 20 feet square.

Details of equipment are much the same as in the other pen systems described. A special advantage of the range system is the ease with which a general inspection of the pens can be made. By looking through the mesh partitions practically everything in a range of pens is visible at a glance.

HATCHING BOXES AND HOUSES

Some of the hatching shelters are scarcely larger than the coops described under the small-pen system, but they differ in that they are built according to the battery system. In the simplest form nesting boxes are built in units of six compartments each, which have ventilating holes on three sides and a vertically sliding door in the other. Small feeding boxes in a series built to correspond are placed against the hatching boxes and the hens transferred to them for feeding and watering. The feeding boxes have a slatted front and a trough along it for the reception of food. Hatching coops with wire-mesh bottoms or none at all can be kept outdoors without other shelter, in which case the eggs usually do not need to be sprinkled with water. At one game farm it was found that a common feeding and exercising run for the hens was best, as the birds thus mingled were placed on different nests from day to day, and the effect of differences in their body heat thus being equalized, a more even hatch was obtained.

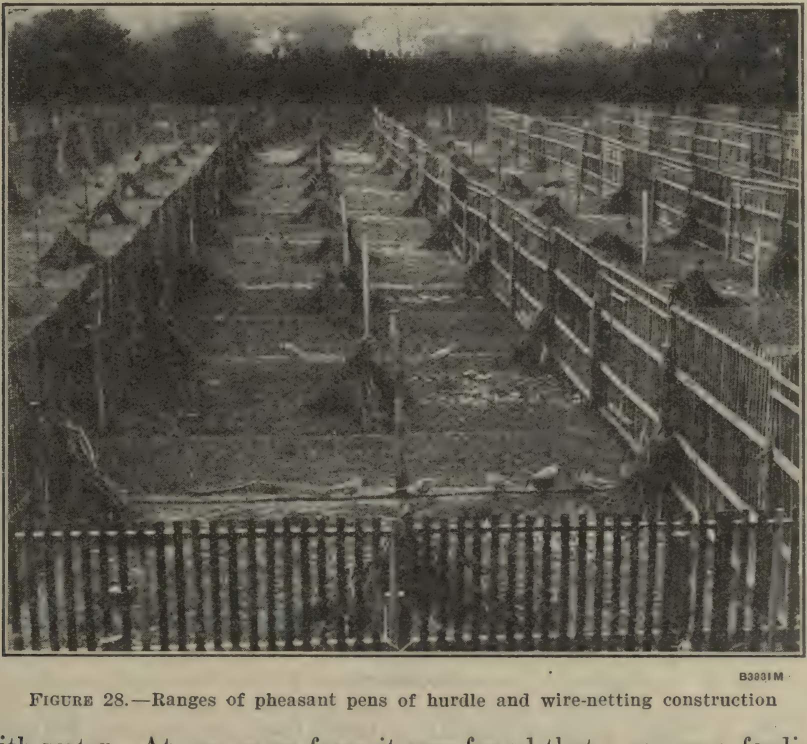
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FIGURE 28.—Ranges of pheasant pens of hurdle and wire-netting construction

Aggregations of these hatching boxes are sometimes placed in a hatching shed that has removable sides, so that it may be kept cool. For the same reason the floor of the shed, the hatching coops, and other things in the shed are sprinkled daily in hot weather. The turf or peat used for the foundations of the nest in the boxes is saturated with water at the time of building the nest, and in unusually hot weather the eggs are sprinkled occasionally.

An item of equipment sometimes accompanying the batteries of hatching and feeding boxes is a box of six compartments, each with a sliding top, which, loosely filled with straw, is used in transferring the young from the hatching shed to the rearing field.

LATE SUMMER PEN

The size of the late summer pen may be whatever available funds will permit. The lower sides are of ¾-inch-mesh wire netting and the upper sides and roof of 2-inch mesh. The lower edge of the fence is buried in the ground or attached to a tier of creosoted planks so buried. The inside height of the pen is sufficient to permit cultivating and planting operations. Rape is the favorite crop. Birds of the season to be used for stocking shooting coverts are kept in such a pen until needed, as well as birds that are to be wintered, until they have completed the molt and have been wing-clipped. Then they have an uninclosed range, as described on page 29, as well as the run of a winter pen, as here described, which is left open and in which hand feeding is continued.

INCUBATORS

On most pheasant farms incubators are used only in emergencies, as when broody hens are not available in sufficient numbers when needed, when hens stop incubating and there are no substitutes, or sometimes to serve the purpose of brooders for short periods when very young chicks are chilled by drenching cold rains or other unseasonable manifestations of the weather.

On the Massachusetts State game farm, however, incubators are exclusively used for hatching pheasant eggs. The eggs are stored in a cellar and turned daily as under other systems of pheasant rearing. (See p. 35–36.) Six hundred eggs are incubated in a machine in one batch. The temperature is kept at 102½° F. for the first week, then raised to 103°. The eggs are turned twice daily, tested on the twelfth and eighteenth days, and infertile eggs removed. Hatching begins at the end of the twenty-second day, and the young are kept in the incubators about one day after hatching. Then they are transferred in woolen-lined baskets to the brooders.

BROODERS

Coal-burning brooders similar to those used for poultry, with the addition of wire-cloth guards to keep the young pheasants away from hot parts, are employed at the Massachusetts farms. Brooder houses warmed by a series of pipes from a central heating furnace also are used, but the pipes are high enough from the floor to clear the heads of the young pheasants and are covered with burlap and a sheet of composition board to prevent the birds from being burned by perching upon them. The temperature in the brooder compartments is kept at about 100° F. for the first 10 days and then is gradually lowered to 90°.

That the birds may have exercise and get water whenever desired, the houses are lighted with electricity at night. Every compartment is washed, cleaned, and fumigated after occupancy by a batch of young birds. Half the floors of the brooder rooms are covered with pine needles and the other half with screened sand.

The brooder houses open on wholly inclosed wire runs divided into four compartments, each sown to clover or buckwheat. For quick results the buckwheat is sprouted before sowing. The birds are admitted successively from one division of the run to another as the green growth is depleted. If the planted food does not become available as soon as needed, chopped lettuce is substituted. Brush is kept in the runs so that the birds will learn to take cover.

At night the young birds are driven back to the heated compartment, but as the time for distributing them approaches the houses are ventilated at night, thus hardening the birds in preparation for exposure outdoors. The birds are confined to the brooder house five or six days, and progress through the sections of accompanying runs at the rate of about one compartment every two weeks. They are distributed to coverts at 8 weeks of age.

INCUBATOR-BROODER SYSTEM

The percentage of eggs hatched by incubators (60 to 75) is less than that obtained under hens (80 to 90), and the losses of young in brooder houses are greater on the average than in rearing fields. On the other hand, equipment under the incubator-and-brooder system is less complicated, less expensive both initially and in the upkeep, and less troublesome to manage than are the hens, the hatching and rearing coops, and the rearing fields needed under the foster-mother system. There is some advantage, too, in keeping the young pheasants at all times away from hens from which they may become infected with disease or parasites.

It is uncertain at present to which system the balance of economy would incline in the long run. Economy is not the whole story, however, and breeders using the more natural methods of pheasant production believe that incubator and brooder raised birds can have neither the vigor and vitality of those grown outdoors in roomy rearing fields, nor the same degree of wildness, a vital factor in enabling them to escape natural enemies when distributed to coverts.

It is also urged, and this criticism applies to both rearing systems, that a true measure of the effectiveness of a game farm is not afforded by the number of 6 to 12 weeks old birds it releases, but by the number that actually reach maturity. In most stocking operations this number is entirely unknown, but on game farms where birds are held for stocking coverts at the shooting season or are reared for sale at maturity the net results of operations can be definitely ascertained.

CARE OF EGGS AND OF YOUNG AND ADULT BIRDS

EGGS

The eggs are gathered from the breeding cages every afternoon, with as little disturbance of the birds as possible. Baskets and buckets are the usual containers, and when all the eggs are collected they are taken direct to a storeroom, where tables with a thick layer of sand, oats, bran, or other poor conductor of heat await them. It has been stated that sawdust, shavings, and excelsior are undesirable for this purpose, as they contain some oily matter, which may clog some of the pores of the eggs and interfere with respiration of the embryo. The eggs are placed on the tables in rows touching one another and turned twice daily, morning and evening. In order that the handler may know which eggs have been turned, the more pointed ends of all should be placed in the same direction the first day.

A dry, cool cellar is an ideal storage place for eggs, and when the temperature ranges from 40° to 50° F. they may be kept safely for 10 or 12 days before setting. When a cellar is not available the storage room used should be dry, and sunlight should be largely excluded.

Putting all eggs through this curing process and not setting them direct from the breeding cages, except in an emergency, contributes to uniform hatching. Time and energy will be saved, as a rule, by allowing eggs to accumulate until enough are on hand to set all the available hens. When there are more hens than are needed for one rearing field, set only enough to produce young birds up to the full capacity of that field. Eggs abnormal in any way should be rejected.

MAKING THE NESTS

After the hatching coops have been disinfected by being dipped in an antiseptic solution or by being thoroughly sprayed with a commercial louse killer, a square of sod should be taken up and some of the soil removed from the underside so as to permit formation of a slight depression. This sod should be thoroughly drenched with water and placed on that on which the coop is situated, giving enough elevation to assure that no damage will be done by heavy rainfall running in. Over the sod a smooth nest of straw or hay should be formed, dusted well with pyrethrum powder, and lined with grass clippings well worked in. Care should be taken to see that the nest is still well formed and smooth a day or two before hatching time.

INCUBATING

Preferences vary as to the type of hen to use for incubating pheasant eggs, but in general unfeathered legs, small size, and quiet disposition are desirable qualities. Hens obviously affected by scaly leg or any other fowl malady should not be used. Turkey hens formerly fancied by some breeders would seem most unsuitable; there is even a tendency to replace these birds with other poultry for the incubation of their own eggs. It is highly desirable that the pheasant farm have a flock of poultry[8] amply large to supply the number of sitting hens needed, but sometimes the crowding production of pheasant eggs makes it necessary to search the country far and near to obtain the necessary broody hens.

When such hens are on hand, it is well to accustom one for a few days to each hatching coop that it is planned to use. Putting in a few hen eggs (hard-boiled ones are most satisfactory) may persuade her to adopt the nest, but these should not be replaced with pheasant eggs until the hen seems well settled down to her task. When satisfied regarding this requisite, place the pheasant eggs in a single layer in the nest, 15 to 18 of them according to the size of the hen, dust the hen thoroughly with pyrethrum powder, and allow her to return to the nest. Inspection in a short time will reveal whether she has properly adopted the eggs; and if so, she may be left in peace. If the hen does not promise to be a good close sitter, the eggs should be given to another at once.

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[8] Information on all phases of poultry raising may be obtained by applying to the Bureau of Animal Industry, U. S. Department of Agriculture.

During the 23 to 27 days' incubation period (average, 24), the hen should be carefully removed from the eggs and liberated in the exercising run every morning, fed sparingly, and watered. Accustom the hen to being removed at a regular time. When approaching the coop make a low signal, clucking, whistling, or the like, but always the same. Lift the roof from the coop quietly, continuing the "conversation" with the hen; pat her back gently, proceeding backward slowly until the tail can be grasped firmly, and the hen lifted up on her legs and urged forward out of the nest. Care in this procedure saves broken eggs. If the day is warm she may remain off the eggs for an hour perhaps, but if the day is cold or wet, the period should be decidedly reduced. The nest should be inspected daily for the purpose of removing broken eggs, washing soiled ones (in tepid water without soap), or rearranging the nest and eggs if not in the smooth and orderly condition necessary to get best results from the body warmth of the hen. It may be necessary also to turn the eggs, as not all hens attend to this necessary detail. In dry weather the eggs should be sprinkled occasionally with tepid water.

Care should be taken to keep close watch for lice, for if these become numerous they will annoy the hen so that she may give up brooding. In such case the coop should be disinfected, the nest renovated and powdered, and a new hen put on the eggs as soon as practicable. Meanwhile the eggs may be temporarily cared for in an incubator or in a flannel-lined basket by the kitchen stove. As a matter of routine, the hen should be dusted with pyrethrum after about 10 days of incubation, and again a few days before hatching time. Pure pyrethrum powder is insisted upon because some of the louse-preventive compounds contain ingredients that have been found injurious to young pheasants.

HATCHING

As the day approaches when hatching may be expected, the first signs of pipping should be watched for. From this time until the young birds are all hatched and thoroughly dry, the hen usually will stay continuously on the nest and should not be disturbed. The second story of the nest frame described in the section on Hatching Coops (p. 26) should be placed about her; this will prevent the tiny young from scrambling away from the hen, and perhaps perishing from cold. Until the hen leaves the nest voluntarily after hatching she should not be fed or removed for any reason. She should have full charge of the young for 24 hours after hatching is completed. They do not need food at this time.

REARING

After this period, and on a sunny day if possible, the hen should be removed with her brood (the hen in a sack or under an arm, the young in a covered basket well filled with straw) to a coop in the rearing field. Place the chicks in one corner of the coop and set the hen near them, holding her with one hand so that she, in her eagerness to care for them, will not step on the little fellows. With the other hand gently urge the chicks under the flank feathers and wings of the hen, when she will settle down to brood. If inspection in half an hour shows all going well, it may be taken for granted that family relations are on the way to becoming established. The hen is confined to the coop, which for the first three days should be provided with a small run made of three boards 1 foot wide to keep the young from straying. The lower edges of these boards and the walls of the coop should fit the ground closely and have no holes through which the pheasant chicks can escape. By being confined for three days the young will receive the extra brooding they need in early life, have a chance to get well acquainted with their foster mother, and, what is especially important, will learn her calls. Some breeders maintain that this can be accomplished by shutting up the birds for a few hours with the hen in the rearing coop. If the hen insists on scratching, thereby endangering the young when in the coop, the trouble can be stopped by setting the coop on a piece of burlap. Some breeders use mesh-bottomed coops and runs to discourage scratching.

After the fourth day the board run should be removed and the position of the coop changed a few feet every day. After the eighth day the hen may be allowed to roam with her brood and the coop should be moved every three days. The tendency of the young pheasants is to cease roosting under cover and sooner or later even to fail to return to the hen. If possible, the brood should be penned in the coop at night when about 4 weeks old (otherwise they must be trapped), and the flight feathers of one wing clipped for the first time.

When about 7 weeks old the birds to be retained as breeding stock, which should always be from early hatchings, are again trapped, clipped, and released into a fresh rearing field. Birds that escape over the fence before wing clipping will try to get back again by running along the outside of the fence. They may be caught in movable traps (fig. 2) or by the use of wings or netting flaring out from the fence and tapering down to a pocket in which they will crouch and can be picked up.

Those to be used for stocking purposes are not clipped, but are kept in covered breeding pens regularly moved about on fresh ground, or in other suitable inclosures. Some breeders use such a rearing pen, covered top, bottom, and sides with 1-inch mesh, to prevent as nearly as possible all losses from natural enemies. Another method of handling flight birds is to keep them clipped until a month before delivery. The stumps of old feathers are then pulled, and new ones will be grown in 25 to 30 days. Birds selected for planting must have the use of their wings to enable them to escape their enemies. Moving young birds away from the hens and coops to a rearing field where there is no shelter should be done in fine weather, not when there is likely to be a drenching rain soon after the change.

CARE OF BREEDING STOCK

The young birds that are being groomed as the next year's breeders, together with any old birds that are retained, are successively transferred to the late summer and to the winter ranges. It is necessary to clip the flight feathers of the growing birds repeatedly; some breeders begin as early as when the birds are 4 weeks old, others make the first clipping at 12 weeks. This latter period falls about September 1 in the Northern States, and the wings are again clipped about October 1 and November 15. The partly grown primaries, never pinfeathers, of one wing only are cut off. The birds are thus unbalanced and efforts to fly tumble them to the ground. With both wings clipped, balance is restored and a fair sort of flight is possible.

TRAPPING

At every wholesale movement of the birds trapping is required, and it is well to explain how this is done. A row of breeding pens is placed side by side across the field occupied by the birds. The hinged boards at the bottom of both ends are left open, and food is scattered for the birds in these cages. Have them in position a week before needed, reduce the quantity of food a day or so before trapping, then bait the traps liberally, carefully urge as many of the birds as possible inside, and let down the gates. Scattered birds not thus caught can be picked up in funnel traps set along the fences, or in general-purpose traps like that illustrated in Figures 2 to 4. A long-handled dip net with a ring and a bag of liberal size is used to catch the birds individually in the large traps. Such a net is handy on other occasions also for scooping up loose single birds. Do not flop it on top of a bird on the ground and thus risk injuring it, but pick the bird up with a sweeping movement that carries the net into the air, where the bag can be folded over the rim so as to prevent the escape of the captive.

MATING

In the spring (late in March as a rule), when the birds are finally caught up for placing in the breeding cages, from 5 to 7, usually 6, hens should be placed with a single cock in each pen. Cocks are selected for size, vigor, and good condition of plumage, and surplus cocks are penned separately and all but a few disposed of as soon as practicable. When the eggs are removed daily from the breeding cages, from 40 to 60 eggs[9] a season can be expected from each hen. Two and three year old hens are the most productive, but without placing numbered bands on their legs or otherwise marking them, it is difficult to distinguish between these classes. Hence the easiest way to assure partial renovation of the stock is to keep for breeders birds of the year, and old birds of mixed ages, in equal proportion. Some breeders mark the birds by punching one, two, or three small holes through the webbing between bases of toes, and thus are able to select by age; one prominent game farmer uses only yearlings as breeders. The birds may be marked as chicks by simply snipping the small webs.

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[9] A maximum of 104 has been recorded.

Bigger and more vigorous birds that will produce more eggs can be reared on the properly conducted game farm that can be purchased from so-called wild stock. If the pheasant breeder has healthy and fairly satisfactory stock, he had better gradually improve it than take the chances on devitalized stock and on the diseases and parasites that are involved in every importation of birds on the farm. Do not be perturbed by fear of inbreeding. That inbreeding is necessarily harmful is a completely exploded theory. All leading breeds of domestic animals have been perfected by the closest sort of inbreeding. Select the very finest birds for breeders, give them and their progeny the best of care, and you need not worry about inbreeding or have occasion to import " new blood."

FEEDING

Feeding is so important a factor in pheasant rearing that it can almost be said that proper feeding insures success. Certainly improper feeding can utterly ruin ventures in which every other factor affecting the birds seems correct. Young birds get their growth quickly and must have a properly balanced diet adequate in vitamins if they are to become well developed. When the bony framework is making its most rapid growth, diet is of supreme importance, and if it is not right, development will be so checked that it will never reattain the normal. Food on the game farm must not only have all the elements that the birds need to make growth and keep up their vitality, but it must always be clean—clean to the uttermost—must be mixed only as needed, fed in just the right quantity, remnants picked up, and in all ways safeguarded so that fermented or stale foods shall be things entirely unknown. The vessels in which foods are mixed should be thoroughly cleaned and scalded each time after using. Regularity in time of feeding also is important.

ANIMAL FOOD

Animal food is essential in the diet of young pheasants. This fact has been realized by gamekeepers everywhere, and their efforts to supply this vital element of the food have been diverse and often extremely laborious, expensive, or otherwise objectionable. Ants' eggs because of scarcity, meal worms because of unreliability of supply, and maggots on account of repulsive features connected with rearing them and their not entirely beneficial effects on the birds have been tried repeatedly and by most raisers given up. Homemade curd, sweet skim milk, buttermilk, clabber, cottage cheese (without salt), custard, fish meal, cooked liver, and meat preparations also have had and still have their vogue. The individual pheasant breeder, however, particularly if operating on a small scale, will do well to use commercial pheasant mannas, chick meals, and the like, the composition of which has been brought to a satisfactory state as a result of cooperation between manufacturers and breeders, and the manufacture of which is surrounded by all necessary sanitary precautions. The largest and most successful pheasant farmers depend to a great extent upon commercial foods, even if they do mix or recombine them to suit individual fancy.

The most important source of animal food for the young birds is the supply of insects that they can glean in the properly prepared rearing field, but this supply should always be supplemented by animal matter mixed with the vegetable food fed. The proportion of animal matter in the prepared food can be varied to suit conditions and can entirely replace the natural supply in the event this fails.

THE FIRST FEEDING

The first feeding of young pheasants should be in the run in which they are confined after being taken to the rearing field. It will therefore be shortly after they are 24 hours old. They are fed every three or four hours during daylight for the first week and are given no more than they will pick up clean in a few minutes. It is better to keep them a little hungry than to overfeed them. Place the food not in a dish but on a smooth board, cleaned after every meal, or scatter it on a new spot of ground every time; dried-up remnants of food will do no harm; soured ones are fatal. The first feeding is given as early as possible in the morning and the last as late as practicable. Some feed only custard (made in the proportion of two beaten eggs to one cup of milk and cooked in a double boiler until nearly dry, and with no seasoning whatever) or grated hard-boiled egg the first day or two; others begin with a mash prepared as follows:

Mix thoroughly cold hard-boiled eggs, chopped fine, with an equal quantity of oatmeal, twice-baked bread or cracker, or commercial game meal, that has been run through a coarsely set chopper that will break it up as finely as desired, but will not pulverize it. The mixed food can be moistened with scalded sweet milk, broth, or boiling water, but only to an extent that will leave it an easily crumbled mash. Never give pheasants sloppy food.

Two boiled eggs and breadstuff mixed as described will make sufficient mash to provide three meals for 15 or 20 chicks. Whether feeding a large or small number of birds, never mix up more mash than will be consumed the same day, and it is safer to provide only for the next meal. So long as a hen is with the young pheasants the food given her should be of a type they can not eat; whole corn seems best, and boiled grain can be supplied if the hen has any difficulty digesting it when fed dry.

LATER FEEDINGS

During the second week intermediate chick grain, rolled oats, or crushed wheat are added to the ration, but no sudden change should be made in the food at this or at any other period. Vary the mixture gradually. Three meals a day are given, of which breakfast may be of the mash advised for the first week; dinner, chick grain or crushed wheat slightly moistened with water; and supper, the first-week mash to which has been added about a third of dry chick grain, rolled oats, or crushed wheat.

When the young pheasants are 2 weeks old their meals may be reduced to two a day, morning and evening. Chick grain, rolled oats, or crushed wheat (wheat flakes), slightly moistened with water, or boiled wheat or rice, and an occasional feed of the first-week mash may be used. The birds are fond of clabber and of curd or fresh cottage cheese (no salt to be added), and these and the egg mash may form a larger part of the diet when insects are scarce in the rearing field, the weather is unfavorable, or when for any other reason the young birds are not making satisfactory growth.

From the fourth week until maturity, almost any dry small grains can be given, as oats, wheat, buckwheat, and scratch feed, but it is advisable, as a rule, to hold down the quantity of corn. It may be fed a little more freely in winter. Cooking at least part of the food, and feeding some mash, are advisable so long as the birds are confined. Breeding birds must have a proportion of animal food (about 10 per cent) before and during the egg-producing season, and it will do no harm to feed on this basis the year round. The grain ration for an adult pheasant is about 1 ounce a day.

LARGE-SCALE FEEDING

The feeding program recommended in previous paragraphs is one practicable for the beginner or the small-scale operator. On large game farms more food manufacturing is carried on, and more elaborate food mixtures are used. On one farm meat and bones from city packing houses are cooked, ground, and dried, and enter more or less into the diet of birds of all ages. Beef scrap and bone meal, buttermilk mashes, and other commercial articles are used by some. On large game farms a great deal of food cooking is done, even the small-grain rations being scalded or cooked for the sake of softening and sterilizing them, and as a means of supplying moisture to the birds.

The following is an example of a mixed ration used for adult birds on a large game farm: Corn and oats in equal bulk ground together, 22 parts; middlings, 11 parts; bran, 11 parts; mealed alfalfa, 5 parts. Mix with this 1 per cent of bone meal and half of 1 per cent of beef scrap on alternate days. For a few weeks prior to the laying season the proportion of bone meal or beef scrap is increased to 10 per cent of the whole. The alfalfa meal is scalded overnight and the remainder of the mixture the day used; when cool mix in the alfalfa, and feed it only crumbly moist.[10] If too wet, middlings or bran can be mixed until it becomes sufficiently dry.

Sprouted oats or buckwheat, mowings of these grains from field crops and grass clippings when fresh, clover, spinach, chickweeds, lettuce, or any available green foods are valuable additions to the diet, especially of the breeding birds. A shovelful of turf thrown in a breeding pen daily provides green food, and a much-relished opportunity for digging. In winter chopped mangels, beets, turnips, or potatoes may be used to supply fresh vegetable food, and alfalfa meal or clover tops, scalded in water or broth, are a substitute. Green food must be supplied to young birds also when they can not be kept on a well-vegetated rearing field. Some breeders have found it beneficial to keep suet available to the birds, hung so that they will have to jump for it.

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[10] "Crumbly moist" means of a consistency that liquid can not readily be squeezed from the mixture, and that a mass of it will easily crumble.

A few details that should be observed in the preparation of pheasant foods may be emphasized. The food materials, whatever they may be—grain, bread, crackers, eggs, or even bone meal—should be cut, not pulverized; in other words, there should be the minimum of dust about such preparations. Powdered food can not be picked up by the birds or thoroughly cleaned up by workmen, and thus tends toward insanitary conditions. Powdery ingredients and too much moisture make sloppy food, and pheasants should never be fed slops. Receptacles and implements used in preparing foods should always be scrupulously cleaned, so that no sour or stale taint will ever occur.

DRY FEEDING

At least one successful American breeder has adopted the plan of feeding dry mashes from the very beginning. Commercial chick manna is used at first and gradually changed to a scratch-feed and beef-scrap combination. These dry foods are made available to birds in food hoppers, which need refilling only about once a week. The hoppers are under practically weatherproof shelters, so that the food never gets wet. Plenty of drinking water is a necessary accompaniment of this feeding system, and it is supplied in capacious fountains of the type used by poultrymen. The great advantage of the dry-feeding system is economy of time; one man can attend to three or four times as many birds as under the wet-mash system. Another advantage is practical immunity of the birds from disorders that arise from soured food. Dry feeding can be combined with the method previously described by keeping a dry mash constantly available to birds after the first week.

WATER

As a rule, fresh, clean water should be available to pheasants of all ages. Some breeders do not give it to young that are fed entirely on moist mashes. Since water generally must be kept in small open receptacles in the cages, it should be renewed daily as a rule, and more often in hot weather. In the rearing field there should be a small receptacle for each coop available to both hen and chicks, and larger ones should be set in shady places elsewhere. Stoneware tends to keep water cool. All receptacles should be shallow and should be thoroughly scrubbed and scalded weekly. When fountains are used they also are completely emptied and refilled daily. In large pens and on the later summer and winter ranges it is sometimes possible to supply running water, certainly a great convenience and labor saver.

GRIT AND CHARCOAL

A mixture of sharp grit, broken oyster shell, and charcoal is kept available to the birds at all times. The pens and ranges for adults have receptacles for this, but in the rearing fields finer grades of the same substances are thrown down with the food to supply the chicks.

VICES

EGG EATING

Some pheasants, especially cocks, form the habit of eating eggs. This is encouraged by permitting broken eggs to remain in the pens instead of cleaning them up thoroughly as soon as found. Increasing the proportion of animal matter in the ration may cure the trouble. If not, it can be discouraged by putting in the pens china or iron eggs painted to resemble pheasant eggs, or partially emptied eggs can be well spiced with kerosene and red pepper and placed in the pen where the trouble is experienced. In extreme cases the offending bird can be penned away from the others until the eggs are gathered, the upper mandible pared at the tip until it becomes too sensitive to be used for breaking eggs, or if the bird is (as usual) a cock, a surplus male can be substituted.

FEATHER PLUCKING

The vice of feather plucking is believed to result usually from a deficiency of animal food. Increasing the proportion of beef scrap or other animal element in the food is the remedy indicated. The possibility of mineral deficiency in the diet should not be forgotten; this trouble can be corrected by adding bone meal to the food. Feather plucking seems more likely to break out where large numbers of the birds are penned together, or perhaps the effects become more rapidly apparent because of the more numerous aggressors upon birds that become the least denuded of feathers or weakened. Such individuals should be removed to isolation pens at once and fed stimulating foods until their plumage and general health are fully restored. The same action is required when birds in the breeding pens develop raw places that will be pecked at by all their companions and enlarged sooner or later to a fatal extent.

DISEASES AND PARASITES OF PHEASANTS

Sanitation, or the practice of methods to prevent disease, must ever be the watchword of the pheasant raiser. Besides the general precautions urged in previous pages (p. 3), it should be emphasized that in domestic poultry is found the source of most if not all pheasant diseases, and game breeders can not be too careful in keeping the two groups of birds and their ranges well separated.

Prevention is the more to be striven for, since treatment in so many cases is impracticable. Some bird diseases spread like fire and in a few days may nullify a whole season's preparations and exertions. The treatments of various troubles as worked out by practical pheasant raisers are given below, and further information on the various diseases, their prevention, and treatment may be had by consulting Farmers' Bulletin 1337.[11]

It is a useful general precaution to give young birds some nonpoisonous disinfectant, such as 8 drops of a saponified cresol solution when a week old, increased to 15 drops later, in 10 quarts of drinking water. Give the solution three days and then alternate three days with permanganate of potash in the proportion of one-fourth teaspoon to 12 quarts of water, a proportion that may be doubled or trebled later. A tablespoon of sulphate of iron to each 100 gallons of water also is a good prophylactic.

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[11] GALLAGHER, B. A. DISEASES OF POULTRY. U. S. Dept. Agr. Farmers' Bul. 1337, 41 p., illus. 1923. (Revised, 1925.)

Regardless of precautions and remedies there will be some deaths, and effort should be made to remove and burn all dead bodies as promptly as possible. The ground where coops from which birds suffering from parasites or diseases have been removed should be thoroughly limed, any litter burned, and the coops disinfected. Sprinkling the ground freely with kerosene and flaming it is another good disinfecting process. As a part of general sanitation also, it is well to remove ailing birds to quarantine, where any trouble they may have will not be communicated to other birds, and where they can be kept under observation and treated.

Sometimes pheasant chicks droop or dwindle, although not apparently suffering from any specific illness. Such a condition is best met by immediate transfer of the brood to a new site, and if necessary by increasing the proportion of animal food in the diet. An outbreak of disease in a rearing field is the signal for immediately abandoning the entire field, which should not be used again until it has been thoroughly renovated.

GAPES

Gapes is the most prevalent and troublesome affliction of young pheasant chicks. As a matter of routine the chicks should be confined to the hatching coop and thoroughly fumigated with a gape remedy every two weeks until they are 8 weeks old. A home remedy is fumigation with a few drops of carbolic acid dropped on a hot brick placed in the coop behind some barrier that will prevent the chicks coming in contact with it. Place a sheet of glass over the coop and watch the chicks carefully. When they show signs of suffocation give them air immediately. The effect of the treatment is to induce coughing, which usually results in the gape worms being expelled. There are commercial gape remedies available, and in using these directions given by the manufacturer should be strictly followed. The danger of prolonged treatment is asphyxiation, but good results have been observed when the birds treated were reeling and seemed about to succumb to the fumes. If gapes become prevalent after the birds are away from the hatching coops, they can be driven into any shed or building that can be closed rather tightly and there fumigated in a flock. As domestic turkeys are now believed to be the normal host of gapeworms, it is inadvisable to use for the rearing of other game birds ground that has been ranged over by turkeys, or to have any of them in close contact with the rearing establishment.

DIARRHEA

As a preventive of diarrhea keep the birds in deep vegetation, and once a week to each 12 quarts of drinking water add one-half to two-thirds of a teaspoon of permanganate of potash. Curds, clabber, and boiled rice also are good preventive agents. As a remedy give no water except that treated with permanganate, and if time can be spared administer olive oil to the birds, half a teaspoonful at a time until it comes through clear. Then feed the birds bread and milk, custard, or other soft foods until they recover.

SCALY LEG

The introduction of scaly leg among the birds can be held in check by treating with kerosene the legs and feet of hens kept for brooders, but this should not be done just before or during the time they are incubating the eggs or brooding young pheasants. Every time the young pheasants are trapped for wing clipping or other reason, dip the feet and bare parts of the legs into kerosene or apply this liquid with a stiff brush. A 5-per-cent solution of carbolic acid is also similarly used to treat scaly leg.

ROUP

Dip into antiseptic solution the heads of birds affected with roup to cure the trouble, and of those unaffected to prevent its spread. Antiseptics suitable for such treatment are: Boric acid, 1 ounce, water, 1 quart; or permanganate of potash, 1 dram, water, 1 pint; or peroxide of hydrogen, 1 ounce, water, 3 ounces. Though it seems rather drastic, some breeders advise the use of kerosene as a dip for treating roup. Others report that putting kerosene in water and food has cured troubles similar to roup.

LICE AND MITES

Head or body lice worry sitting hens, sometimes to such an extent as to make them desert their nests. Lice retard the growth of young pheasants and may cause their death. The thorough disinfection of hatching and rearing coops before use and the application of a louse powder to the nest and hen before hatching time have been discussed in previous pages (p. 36–37). In case a few lice may have escaped these treatments it is well to turn up with a stroke of a hoe a little bare earth near each coop in the rearing field, where the young birds can dust themselves. A little lard applied to the heads of the infested chicks will destroy the mites. The application should be made on a warm, sunny morning, when it will dry quickly.

If the behavior of a sitting hen indicates an infestation of night or spider lice, examine the coop at night, when the mites are more active and can be seen crawling about. If any number are found, spray the hen and the eggs with a louse killer and remove to a new nest; then burn the old nest and remove the coop for thorough disinfection with a coal-tar dip or spray.

AVIARY, OR FANCY, PHEASANTS

In this country all pheasants, other than the ringneck and its close allies used for stocking coverts, are known as fancy or aviary pheasants. The kinds of pheasants that are regularly dealt in and can be obtained with reasonable certainty in the United States at almost any time are the ring-necked, black-necked, Chinese, Mongolian, golden, silver, Lady Amherst, and Reeves's pheasants, and the Manchurian eared pheasant. Others that can be had occasionally are the Swinhoe, Impeyan, Japanese or versicolor, Elliot's, Soemmerring's, and Formosan pheasants, and the Nepal, black-backed, black-breasted, and lineated Kaleege pheasants. Most kinds of pheasants will adopt a polygamous habit, and it is this quality that fits them so well for hand rearing and restocking purposes. Some few of the rarer species, however, seem to insist on strict pairing, examples, according to present information, being such species as the Kaleege, Tragopan, and Impeyan.

Although the species classed as aviary or fancy pheasants have the reputation of being wilder, more nervous birds, and poorer breeders than the ringneck and its allies, differences in methods of rearing them are necessitated not so much by these characteristics as by the fact that they are reared only in small numbers. If the market justified the attempt, probably several of these species could be handled by the same large-scale methods that are used for the ringneck. Under present conditions of limited market, however, these birds are reared by most breeders only as a side line to the ringnecks. For the sake of economy, therefore, they must be handled with the least additional trouble, and for convenience they are kept separate from the ringnecks and from each other. The different species of pheasants will fight among themselves more than will individuals of any one species; hence they must be separately penned. A common rearing field is impracticable, because the hen foster-mothers would persecute stray chicks of a kind obviously distinct from their own brood.

These factors have guided the development of fancy pheasant rearing along lines very different in some respects from those obtaining in the ringneck business. Where aviary pheasants are raised as a side line the breeding pens are usually larger and remain on the same ground the whole season, thus saving labor. This plan works better with these birds than it would with the ringneck, as the fancy pheasants are not so inclined to eliminate every stalk of grass from their pens and then dig up the roots as is the ringneck.

The fancy pheasants also are given more effective protection from the weather in the breeding cages, and on winter range are placed in the most sheltered portion. Usually, however, the birds are in cages or runs of only moderate size the year round. One of these is the breeding cage, while others correspond to the rearing field and to the late summer and winter ranges used for ringnecks.

Fancy pheasants, never intended for liberation, are pinioned by cutting off the last joint of one wing when the young are 3 or 4 days old. This removes the necessity for the periodical clipping of flight feathers, as pinioned birds will never grow primaries on that side and never will be able to fly. Directions for pinioning are given on page 20.

One specialist in rearing fancy pheasants, who has bred no fewer than 16 species, keeps the birds penned at all times. His breeding cages are much like those described under the movable-pen system (p. 22–25), but stand on the same plot of ground all the season. His hatching coops are placed in similar pens, 12 by 15 by 5 feet in dimensions, the walls and top of 1-inch mesh. The coops and pens are of knockdown construction, so that all parts can be handled by one man and piled flat for transportation or storage. The birds are reared in the same pen where hatched, and this is not moved during the season. The system of spacing and moving illustrated in Figure 18, A, is used, with the difference that the pens are moved only once a year and thus are on the same field four seasons instead of one. This gives plenty of time to renovate by cultivation and crop rotation another area to serve as the next rearing field. Stock not sold is wintered in a breeding or similar type of pen. The feeding methods of this breeder are described as the dry-feeding system (p. 43).

BOBWHITE QUAIL[12]

Though for many years the propagation of the bobwhite[13] was regarded as difficult or impossible, the combined efforts of a number of game breeders have solved the difficulties one by one until the methods of handling quail are as well developed and as successful as those used for the ring-necked pheasant. The Virginia State game farm, where propagation of this bird has been brought to the highest degree of perfection, is well equipped, and is as methodically operated and efficient in production as any pheasant-rearing establishment. Several thousand bobwhites have been reared on this farm in each recent year and distributed to coverts in the State. Production on a still larger scale merely awaits the demand that will justify it. Other species of native quail no doubt can be bred successfully under the same system as the bobwhite, with such minor modifications as climate and locality require.

The equipment and system used in quail propagation are similar in a general way to those long tried in the pheasant industry. Differences are chiefly those necessitated by the smaller size of the birds and their nonpolygamous nature, and to a lesser degree by their greater wildness and special dietary requirements. Because instructions relative to pheasant rearing have a general application here, details will not be given except to make clear the important differences in equipment or methods.

BREEDING STOCK

Ordinarily birds trapped in the wild will be most available as foundation stock for the prospective quail breeder, but much better results are had from birds raised in captivity. Wild birds may be caught in a variety of types of quail traps, but the simple funnel trap (fig. 29) baited with scratch feed is efficient and inexpensive. Traps of this type should be visited twice daily, if possible, and if only once, that call should be late in the evening, so that there will be little chance of birds being in a trap overnight. Otherwise, some predatory enemy is likely to find the trap occupied, wreck it, and probably destroy all the birds. The flight feathers of one wing of captured birds should be clipped, and, dependent on the season, the birds can be placed in a large wintering pen (described later) or arbitrarily paired and domiciled in breeding pens. There are some indications that quail in captivity may tolerate a degree of polygamy.

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[12] In this connection the following publication will be helpful: STODDARD, H. L. REPORT ON COOPERATIVE QUAIL INVESTIGATION: 1925–26; WITH PRELIMINARY RECOMMENDATONS FOR THE DEVELOPMENT OF QUAIL PRESERVES. 62 p., illus. Washington, D. C. 1926.

[13] "Bobwhite" seems to be the most satisfactory distinctive term for the species called "partridge" in Southeastern and "quail" in Northeastern States. The term quail, although applied to different birds in Europe, is understood in this country to cover practically all the native gallinaceous game birds smaller than grouse, prairie chickens, and ptarmigans.

BREEDING PENS

In the construction and use of breeding pens for quail there are several departures from the usage in pheasant rearing. The quail pens (fig. 30) are 5 feet wide, 10 feet long, and 4 feet high. The back half of each is boarded solid and has a waterproof roofing, which keeps the feed trays and dust bath always dry and protects the birds from hot sun or stormy weather. The front half is sided and roofed with hardware cloth, three meshes to the inch. Boards are placed around the bottom of the pen to the height of 16 inches, as the birds are much better contented when they can not see out. A ditch ample to carry off any storm water is dug all around the pen and part or all of the dirt from it is banked against the bottom of the pen to give greater safety from natural enemies.

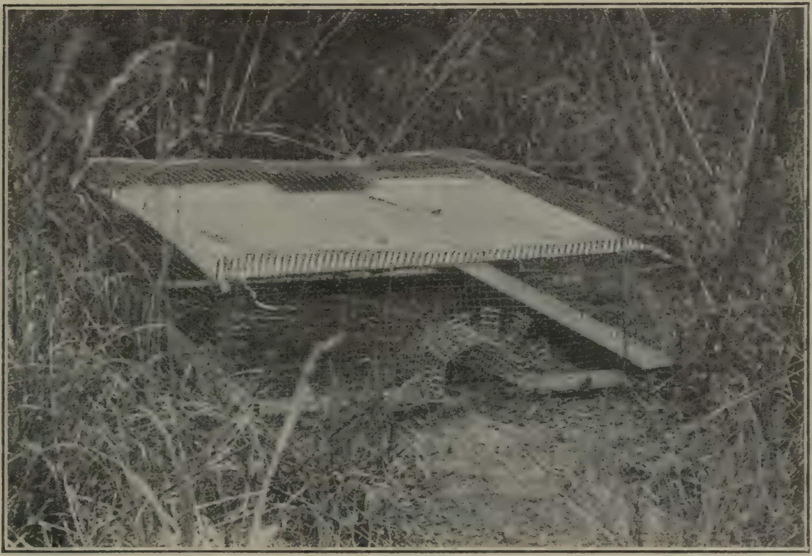

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FIGURE 29.—Quail trap. The small mesh (½-inch) and cloth-top fender both minimize danger of captives injuring themselves. The fender, which should be taut, may be made of almost any strong cloth, but ½-inch mesh cord netting has the advantage of lower visibility

The pens should be placed in the sun on well-drained land that has a good natural growth of vegetation or has been seeded to clover, wheat, oats, or any other crop that will furnish green food. In the absence of growing vegetation chopped lettuce can be fed. Small brush piles under which the birds can hide or make the nest should be provided in the cage. Plenty of growing plants (broom sedge is good) in the pen, providing cover, is insurance against the birds damaging themselves by flying against the wire. The birds are fed and watered through a small door in the back of the pen.

The door in the front of the pen is large enough for a person to get through, but in order to keep the birds as quiet as possible the keeper avoids approaching the front except once each week, when the eggs are collected. When coming to the breeding pens for any reason it is well to give a low whistled signal, which the birds will soon learn. They will then crouch under cover and probably remain quiet while the keeper is renewing food and water or gathering eggs. Sometimes a box shelter is furnished to which they can retreat when alarmed. Without such precaution the birds may easily injure themselves, as their characteristic explosive burst of flight dashes them against the walls of the pen. Some breeders have taken the precaution to drape the entire ceiling of the breeding pen loosely with burlap to protect flying birds from injury.

Once a week with all care and quiet the eggs are gathered with a spoon firmly attached to a long slender stick, one or two of the freshest being left in the nest each time to keep the female striving to complete a clutch. On the Virginia State farm numerous bobwhite hens have laid 90 or more eggs each in a season, and 128 were obtained from one. Birds reared in captivity lay better than wild-caught individuals, and egg production is well sustained; 4-year-olds have been known to produce 90 eggs in a season.

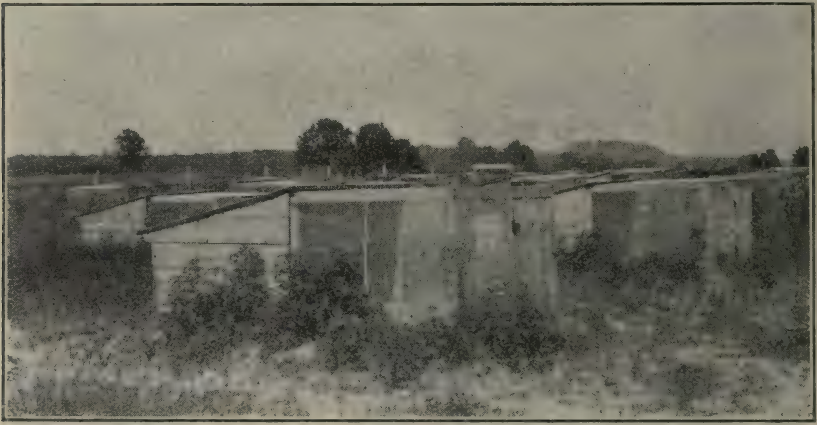

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FIGURE 30.—Quail breeding pen

HATCHING THE EGGS

Quail eggs are stored and cared for in just the same way as those of pheasants (p. 35–36). Clean-legged bantam hens are used for incubating and are prepared for their task by dusting with insect powder before being placed on the eggs, and twice thereafter. The third application should be made not less than four days before the hatch is due. The incubation period is 22 to 24 days. The hatching boxes are placed on the ground under low, narrow shelters (fig. 31), and when thus arranged it is not necessary to sprinkle the eggs. In hatching houses the eggs are sprinkled with tepid water two or three times weekly.

Three inches of dirt is put in the bottom of the hatching box to prevent flooding, and over a depression in it a well-formed nest of fine hay is made. Fifteen to eighteen quail eggs, depending on the size of the bantam mother, are put in each nest. The hens are taken from the nests about 9 a. m. and put in feed boxes (fig. 31), where they are fed and watered, and the eggs allowed to cool for about 15 minutes. As soon as the eggs begin hatching, the nest boxes are darkened (fig. 31, back row) so as to keep the hens as quiet as possible. The hens are left on the nests until about 10 hours after all the eggs have hatched.

BROOD COOPS

When all the young quail are hatched and dried they are transferred with their foster mother to brood coops with small boarded runs attached. (Figs. 32 and 33.) These coops are 20 inches square, 2 feet high in front, and 1 foot at back, with a 5-inch strip of ¼-inch-mesh wire across the front and a number of small holes bored in the sides for ventilation. There is also a ceiling of fine-mesh wire in the coop 1 foot from the floor. This keeps the bantam from jumping up to the light coming through the ventilator, an action that may result in fatal trampling of the quail chicks.

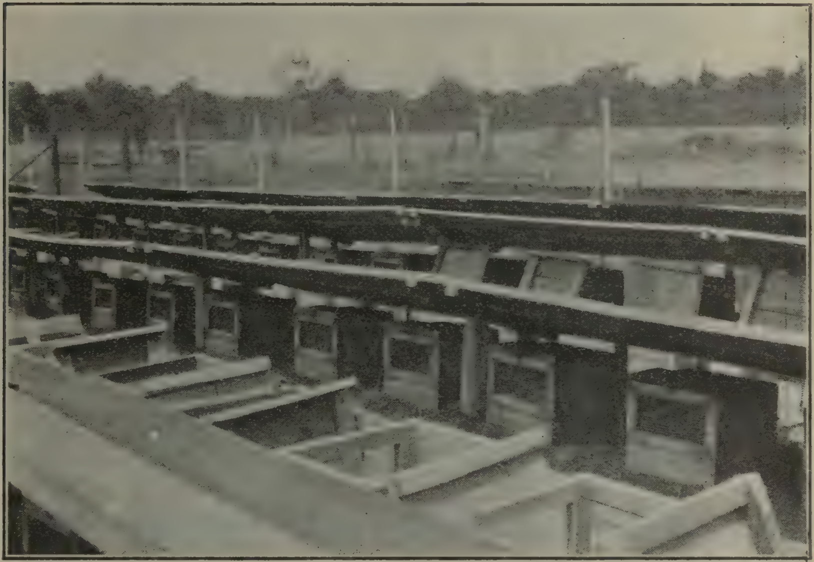
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FIGURE 31.—Quail hatching boxes

The coops are floored also to reduce the amount of scratching done by the hen, another cause of death to the tiny quail. The floor is covered with fine hay or other litter before the birds are put in. The coops are hinged at the back and provided with a hook and eye in front so that they are easily opened and cleaned. A small hinged door at the bottom in front will pass the bantam, and a lower slatted entrance with suitable stopper is provided for the quail.

A board run 12 inches high, 20 inches wide, and 6 feet long is fastened flush to the front of the coop. The coop should be placed in dense but short grass on new or renovated land and should be set well into the ground to prevent the escape of any of the young birds. Before the birds are placed in the coop, clean coarse sand is spread all the way across the run against the front of the coop; this makes a pathway, the upper edge of which is flush with the floor of the coop, and also provides grit for the birds. Baby-chick-size charcoal is scattered in each run. The quail chicks are shut up in the coop with the bantam at night. It has been found practicable also to use cock quail for foster parents. (See p. 18.) The cocks and broods are kept together three weeks and all shipped in company for liberation in coverts.

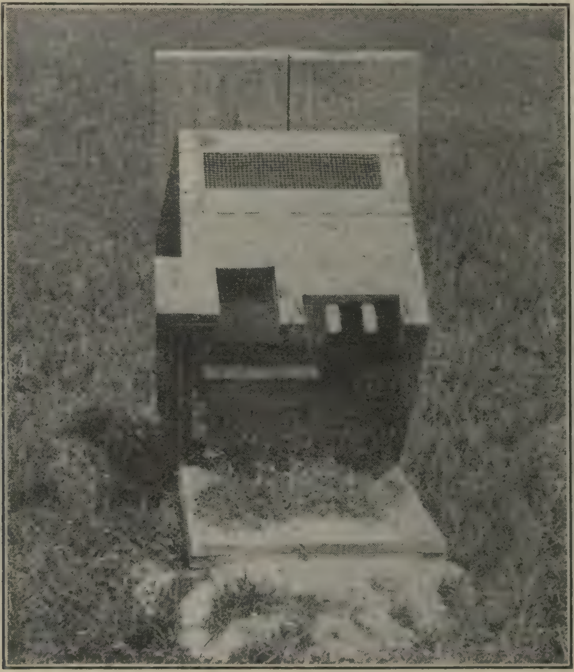

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FIGURE 32.—Brood coop for quail

INCUBATORS AND BROODERS

In experimental work at the Virginia State game farm, incubators have been used for quail eggs, and an average hatch of about 74 per cent obtained. A small type of commercial brooder also has been used successfully. The brooder is housed in the back of the closed compartment of the coop with a low cover of wood over it and with a partition placed against the edge of this cover to form a snug retreat for the very young birds. As the chicks grow the partition is moved farther away, permitting them to choose the degree of warmth they desire. Other things being equal, the use of brooders is an advantage in keeping the chicks away from bantams, thus greatly reducing the risk of infections. Twenty chicks are allotted to each booder. When larger numbers and larger brooders were tried undesirable results became apparent. Incubator and brooder-raised birds kept with cock quail foster parents have been distributed to coverts when 3 weeks old.

REARING PENS

When the birds to be kept with bamtams are 5 days old, or those with brooders a few days older, they are moved to wire pens, a section of which 10 by 30 feet in extent is cut off by a partition fence from an adjoining run 30 by 50 feet in dimensions. The lower part of the netting is of ½ or ⅓-inch-mesh hardware cloth extending several inches into the ground and reinforced above the surface with 8 inches or more of boarding. The small-scale breeder can save money by using coarser mesh and lining his pens at the bottom with tar paper. The grass is left long in the larger but cut short in the smaller pen in which the coop and bantam are placed. A useful adjunct for the rearing pen is sunflowers, which furnish shade and later seeds for the birds.

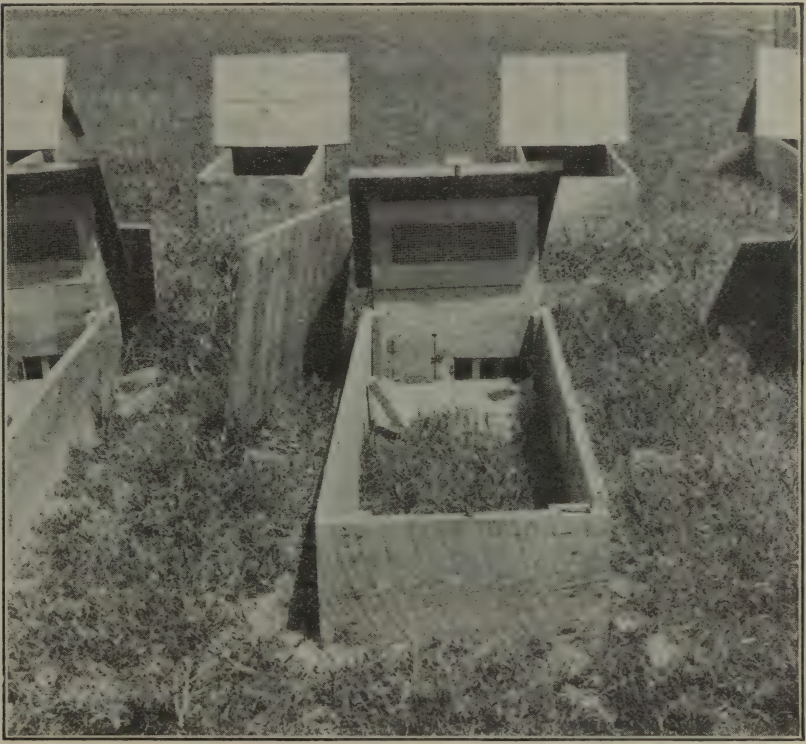
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FIGURE 33.—Quail brood coop with boarded run

When 2 weeks old, the quail are given range of the larger pen, which they enter through holes at the bottom of the partition fence (fig. 34) small enough to exclude the bantam. Birds reared in these pens at the Virginia State game farm are distributed to coverts at 6 or 8 weeks of age. When the object is to hold birds to maturity, it probably would be better to adopt the rearing-field system as described for pheasants, and see that the birds are kept well wing-clipped.

FEEDING

On the Virginia State game farm, under the first notably successful feeding system developed, only clabber from which the cream has been skimmed is fed for the first four days. It is put on a small dressed (and therefore easily cleaned) board, and this is placed close to the coop, so that bantam can have a share. The first feeding is given six or eight hours after the young quail have been transferred to the coop; the number of feedings is four a day. So long as clabber is fed no water is given. Ripe tomatoes torn open and stuck on nails driven through small boards also are kept before the birds almost from the first.

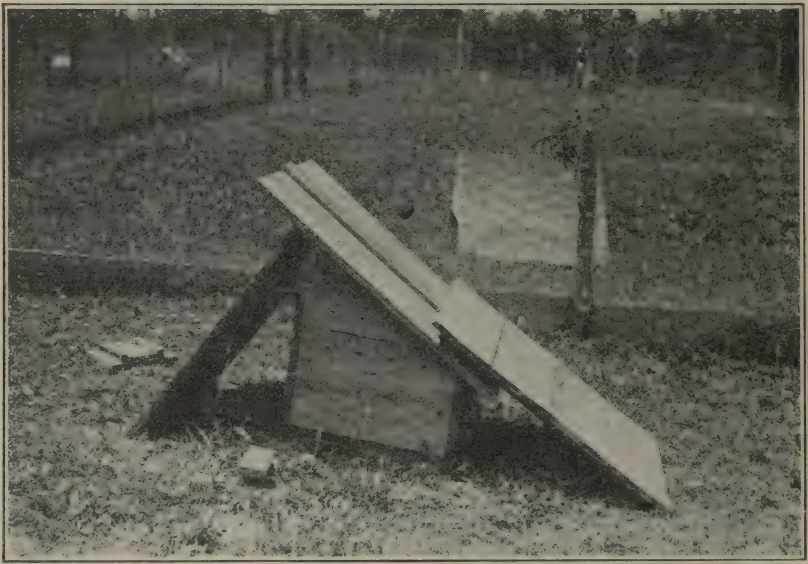

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FIGURE 34.—Rearing pen for quail. Note shade provided, holder for clabber dish (left), and opening through baseboard (seen to the right of the coop) to larger section of range

In the rearing pen, clabber is constantly available to the young birds in small granite-ware dishes kept under waterproof shelters. A wooden disk, nearly as large in diameter as the inside of the dish, keeps the quail chicks from getting into the clabber but allows them access to a little of it at a time. Later, when the birds are bigger, the disk is supported above the clabber by four nails driven through it, still serving to keep the chicks out but allowing them to feed more freely. Clabber and millet seed constitute the food up to 2 weeks of age, when fine chick grain, rolled oats rubbed fine between the hands, and millet seed may be given in wooden trays under the waterproof shelter. Quail have been successfully reared on mashes either wet or dry as described previously in this bulletin under pheasant feeding (p. 40–43).

The bantam foster mothers are kept well fed on coarse food too large for the young quail to swallow.

Food for adult quail also is supplied in trays—hoppers no doubt would serve—kept sheltered from the weather. The trays are made with strips extending inward from the top to prevent the birds from scratching out the food. It prevents contamination of the food to set the tray on a frame covered with hardware cloth; under this is a sheet of tar paper. Scattered food falls through the mesh where the birds can not get it, and is held by the tar paper, from which it is easily removed and discarded. Food that has been found suitable for adults includes chick grain, pheasant meal, scratch feed, kafir corn, small cowpeas, wheat, buckwheat, millet, canary seed, rice, and rolled oats in varying mixtures, and commercial mashes for poultry. Sometimes a little beef scrap is added, especially before and during the laying season. Green food also is then needed. The birds must not be too fat at this time. Exercise will help to prevent fattening; hence in the winter pen, scatter food in the ground litter so the birds will have to hunt for it. Clabber is kept constantly available to the breeders. In winter, apples, turnips, beets, and cabbages are useful relishes, and in summer, wild berries of any sort and ripe tomatoes are used. Clean coarse sand, charcoal, baby-chick-size oyster shell, and fresh water are constantly available to the birds.

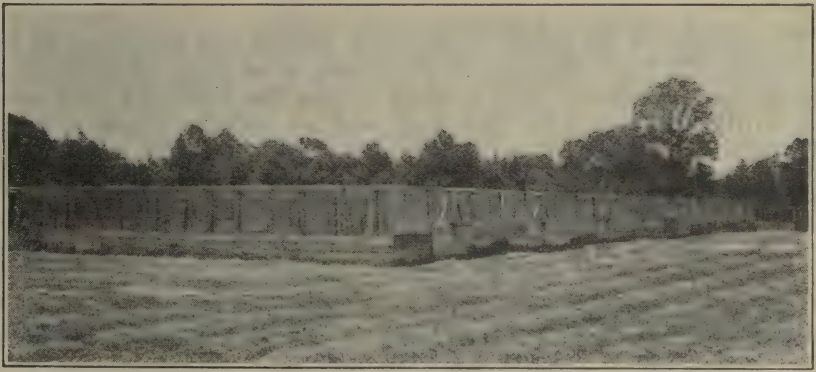

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FIGURE 35.—Community pens for quail

WING CLIPPING

When the young quail are 3 weeks old they begin flying. A few flight feathers on one wing are then clipped from birds that are to be released at 6 or 8 weeks of age. Those to be kept for breeders should have all the primaries of one wing clipped every two weeks until grown. Adults can be clipped once after molting. In performing this operation avoid cutting pinfeathers.

COMMUNITY PENS

Community pens (fig. 35), used for keeping breeders until put in the breeding pens, for wintering the birds, and for holding surplus birds at other seasons, are about 12 by 70 feet in dimensions (on the

Virginia State farm; elsewhere larger pens have been used). They are walled and covered with 1-inch-mesh wire netting, and the lower edge of the netting is attached to an 8-inch board placed in the ground to exclude enemies. As an additional protection, they are boarded around the bottom to a height of 2 or 3 feet. Burying the netting in the ground and lining it with tar paper above ground, or substituting galvanized sheet metal for the lower parts of the walls, are alternative types of construction. Both board and brush shelters are provided, and for winter part of the floor is covered with pine straw or other litter.

The pens should be high enough for men to work in them, or for horses if it is preferred to use these animals in renovating operations. A sufficient number of these pens should be available so that part may be vacated while the soil in them is broken up and while they are limed and cultivated and new cover crops are grown. To provide green food in the spring, oats, wheat, clover, or mixed grasses are sown in the fall; late summer cover would have to be provided by spring sowing.

STOCKING COVERTS

Precautions to be taken in stocking coverts are the same as for pheasants (p. 18). Manage so that there is no burst of flight from the shipping container, and arrange so that the birds can only creep out slowly, one at a time, find food, and see nothing to alarm them. The person releasing them should retreat quickly after opening the crate. To hold birds on a given area, have it planted in advance with seed producers attractive to quail. For details see page 17.

QUAIL DISEASES AND PARASITES

Much has been written but little is definitely known about a so-called " quail disease." There is no such specific malady, for the same or very similar symptoms have different injurious microorganisms associated with them, and it is usually impossible to say which is causative in occurrence and which secondary. Probably it is better to refer to quail disease as bowel trouble and to state that it is related in symptoms, and doubtless in cause, to the diarrheas and similar illnesses affecting poultry. It is not known to occur among wild quail, and is prevalent in proportion to the closeness, insanitation, and length of confinement.

Prevention is the main hope of avoiding losses through disease. Thorough sanitation at every step, and especially with birds being shipped, is necessary. The value of uncontaminated ground is as great in the case of quail as of pheasants, and the methods of assuring it are the same.

Mild outbreaks of bowel trouble may be treated by administering a third of a teaspoon of extract of catechu in each gallon of drinking water. In addition to the catechu about 15 grains of permanganate of potash may be added to guard against other infections. Moving the birds to fresh ground and giving them plenty of space are effective steps to take in stamping out disease.

Bantams, while otherwise valuable as foster mothers for quail, are reservoirs of diseases fatal to the young birds, and it pays to release as many chicks as possible in the care of bobwhite cocks. (See p. 18.) Tapeworms sometimes cause serious losses of quail chicks, and it is said that some of these are acquired by the birds in eating house flies. Young have been reared in finely screened coops to prevent this trouble. Adult quail, particularly in the South, are universal carriers of coccidiosis, and in the adoption methods suggested here it is well to take all possible precautions to keep the young birds from pecking at the feces of the adults. Putting a raised floor of fine-wire mesh in the introduction cage will aid in this respect.

OTHER QUAIL

As a group the native American quail seem to be well adapted to rearing in inclosures. So far as known methods of handling other species can be adapted with little change from those found practicable in the case of the bobwhite.

HUNGARIAN PARTRIDGES

The Hungarian partridges now established in North America are almost exclusively the descendants of birds that have been imported and released directly into coverts. In European countries propagation of this species takes the form of various expedients to aid the wild birds, and pen raising is considered impracticable. The partridge has been reared in confinement, however, and it is probable that with persistent effort full success will be attained. With Hungarian partridges, as with most other game birds that have been propagated, the superiority of hand-reared over wild stock is very marked, and it is probable that when artificially propagated breeding stock is freely available the rearing of Hungarian partridges in inclosures will not be considered unusually difficult.

Hungarian partridges, like our native quail, are scarcely polygamous and must be penned in pairs. Because of great similarity in plumage of the sexes, and variations due to age, arbitrary pairing is impracticable. The birds are said to do best with mates of their own choosing, and to obtain natural pairs the following system has been developed:

The community pen in which the flock is kept is provided with small connecting pens, the outlets from which can be closed by a door released by a cord from a convenient blind, where an observer conceals himself as the mating season comes on. Pairs have a tendency to withdraw from the flock, and are likely sooner or later to wander into one of the small pens, and then the door can be dropped. Even then the birds should be watched, for should a third one come to the door seeking entrance to the small pen it is likely to be the mate of one of the penned birds. In such case the door must be lifted and another occasion awaited. When a true pair is isolated from the flock, they can be caught and placed in a breeding cage similar to those recommended for quail.

If all birds are provided with numbered leg bands and a record kept as to sex, the same pairs may be mated a second season, or other arbitrary pairing combinations tried. No fewer than 52 fertile eggs have been obtained in a season from a single pair on an

American game farm, a good augury for the future and an indication that pen rearing can be made more effective as a means of increasing the species than any of the systems of aiding the wild birds, although it will be more expensive and will be the method for the professional game breeder, rather than for farmers and sportsmen. The period of incubation is reported to be from 21 to 26 days.

Rearing equipment and methods may be much like those for quail. The Hungarian partridge, like the bobwhite, starts its flight with a tremendous burst of speed, and great care must be observed to prevent the birds from injuring themselves by dashing headlong against the walls of inclosures. Breeding stock should have the flight feathers clipped, but adults to be liberated must be full-winged, and young, although clipped, if kept in pens during early life, must be allowed to grow full-length primaries before release.

Hungarian-partridge chicks, according to present experience, seem very dependent upon a good supply of animal food, and a rearing field with abundant insect life should be available for bantam-mothered birds. Cock Hungarian partridges are devoted parents, however, and if a supply of surplus cocks is available it is well to release the young in their charge as early as practicable. Directions for assuring adoption of the young are given on page 18.

Feeding may follow, probably with equal success, either the plan recommended for pheasants or that for the bobwhite. One successful American breeder uses hard-boiled eggs and fine oatmeal for the first few days, after that adding partridge meal, and later millet, hemp, and canary seed. Adults prior to and during the breeding season are given millet, hemp, wheat, cut oats, and meat scrap. In winter buckwheat, millet, and wheat are fed.

Where game farming can be carried on in connection with a range stocked with Hungarian partridges, it is the usual practice to take the first clutch of eggs, particularly from nests that seem too exposed or otherwise liable to destruction, and set them under small hens or place them in incubators. The female partridge will then lay another set of eggs. Young hatched at about the same time as those of wild birds sometimes are released close to the nests and they are quickly adopted by the wild pair.

NATIVE GROUSE

If grouse trapped wild are used as foundation stock, the chief difficulty arises from their extreme shyness. They should be wing-clipped, so that they can not dash against the wire, kept in roomy inclosures with plenty of cover, and accustomed gradually to visits of the keeper by always feeding at the same place and moving cautiously at all times.

Grouse are too valuable to keep in uncovered pens and should be thoroughly protected against vermin. In winter a community pen may be feasible, but in the breeding season each pair of ruffed grouse must be given a separate inclosure. The males are pugnacious among themselves and severe with the hens in mating. Sometimes it is necessary to keep the cock away from the hen, except for the short periods actually necessary for fertilization.

It seems necessary to allow the hen to complete a clutch of eggs before they are taken, and then she will sometimes lay another.

Unless this happens regularly there would seem to be little advantage in taking the eggs away from the female at all, for grouse are good mothers. However, birds reared by hens will grow up tame, and if successfully held over will provide more manageable breeding stock. By this method eggs obtained from the nest of a wild bird can be used at the start. Twenty-four days is the period of incubation.

The system of rearing can be the same as for quail, but be sure the young birds have plenty of shade; strong sunlight will kill them in a short time. As ruffed grouse grow up, it seems almost necessary that they have more or less of the food they naturally get in woodlands. Their range should furnish browse and buds, and wild fruits and acorns can be supplied from time to time. Grouse of the open country, like prairie chickens, probably can be raised by the same methods as quail.

WILD TURKEYS

The greatest difficulty in connection with the propagation of wild turkeys is to get birds of the true wild stock. The turkey that is native to the Eastern United States, over most of which it originally occurred, has a plumage that gleams like burnished metal; the rump feathers are dark reddish apically and the tail is dark reddish in general and dark brown at the tip. In the domesticated turkey, which is descended chiefly from Mexican stock, the tips of these feathers are whitish and the plumage in general is less metallic. Tame turkeys, however, readily become wild, so that if pedigree is not an important consideration, almost any stock will do, for the birds can be so managed that the progeny will be wild enough for sporting purposes.

The breeding birds, either wing-clipped or pinioned, are kept in a roomy field of the old-pasture type with plenty of natural growth. It is well to have a separate range for young males, as otherwise they will be persecuted by older ones; one adult tom is sufficient for several hens.

The breeding pen is partitioned off from a liberal range of woodland, all under fence. One successful breeder uses a 9-foot fence, of which the lower 5 feet is ordinary farm-stock fence graduating from small mesh below to larger above and the upper 4 feet of coarse mesh. This is not vermin-proof, and when such a fence is used natural enemies must be dealt with otherwise than by exclusion. In the smaller field is a poultry house divided into compartments provided with roosting perches. The upper half of the front of the house is of wire netting, and the lower half of doors that can be closed at night and on stormy days. Usually the birds must be driven in, but feeding them there at times and keeping a dry mash available in hoppers will reduce this difficulty. Some breeders allow the birds to roost in trees. Brush heaps are scattered over the breeding field, and the hens lay under these.

The eggs are removed daily, one genuine or one dummy egg being left in each nest. They are set under hens in ground nests under the shed. The young are handled like pheasants in a rearing field and are shut in with the hen at night and also by day until the dew has dried off, or in wet weather. Some breeders use female domesticated turkeys for foster mothers. The young are allowed free range with them at from 10 days to 2 weeks of age. This system obviates dangers of contracting poultry diseases. In some cases the wild-turkey hen is robbed of one clutch (about 18 eggs), then allowed to incubate what she lays later and to rear the brood. Under this system she should be full-winged.

Another plan is to give each female turkey a roomy individual pen, to which the male is admitted when the actions of the birds indicate the proper time, but from which he is excluded at all other times. The smaller pens should have plenty of brush and growing cover and old leaves or other litter on the ground, in which the nests can be formed. The period of incubation is 28 days.

The food for young turkeys may be much the same as that for pheasant chicks, though some breeders have found the use of clabber fully as beneficial in results as it is in the case of quail. Avoidance of overfeeding is very important.

Breeding birds are fed on a mash composed of bran, cut oats, wheat middlings, and corn meal in about equal parts. This is moistened with fresh milk, and after the female has begun to lay, a fresh hen egg, including the shell, is added to the mash for each bird to be fed. Beef scrap also is made available, so that the turkey hen can take what she needs. After the short period allowed for feeding, however, all remainders should be cleaned up.

Adult birds are fed like chickens, except that, in addition, patches of wheat, buckwheat, millet, corn, and the like are sown for them. To allow cultivation and growth of these grains the range of the breeding birds should be partitioned into two approximately equal parts, in either of which the birds can be confined as desired. The planting of grain patches also serves to hold the birds in coverts that are stocked.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

December 10, 1929

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BUSINESS RECORDS FOR POULTRY KEEPERS

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USEFULNESS OF POULTRY RECORDS

MOST POULTRY KEEPERS find that it pays to keep records of current operations to guide their efforts in profitable directions. Some of the reasons for keeping records are as follows: (1) They reduce the guesswork in poultry farming by helping the farmer to determine the actual reasons for poultry profits and losses, (2) they tend to show the relative efficiency of different methods of production and marketing, (3) they make it possible for a poultry keeper to compare his results with published information on many poultrymen's problems, (4) they show the financial progress a poultry keeper has made in his business, (5) they furnish information for credit statements when funds are borrowed, and (6) they help to prevent disputes by serving as a check on business dealings.

This bulletin brings together a variety of forms of records usefel to poultrymen. No poultryman has occasion to use all of them in full detail all the time; the interest in and need for detail should settle the matter with each poultryman. The bookkeeping needs of the farmer whose poultry is a side line are less exacting than are those of the poultryman who specializes in egg production or in other phases of poultry farming. The forms shown are likely to need some modification for any individual case; more columns or more lines may be supplied to preserve a record of the facts needed to answer questions not here anticipated.

WHAT RECORDS TO KEEP

The records needed to find the amount of return for the year are the cash accounts and the annual inventories. The inventories show the size and condition of the enterprise at stated times; an increase during a period may be considered as equivalent to a receipt of cash, and a decrease may be considered as an expense. Some kind of cash account of receipts and expenses is usually kept, providing a balance, used as a measure of the return. Such a balance is an incomplete statement of returns without consideration of inventory changes and estimates of the value of home-grown feeds, especially on general farms. Egg-production records are almost universally kept. These three sets of records should be kept by every poultryman in detail sufficient for his needs. (See p. 3.) In addition, other special records are helpful under certain conditions, as is pointed out in connection with the following forms.

A list of the typical records discussed in this bulletin follows.

Records all poultry raisers should keep:
- Inventory, Form 1.
- Receipts and expenses, Forms 2, 3, 4.
- Egg production, Form 5.

These records, plus the estimated value of home-produced feeds and the value of meat and eggs used by the household, give the financial results of the poultry business for the year. The distribution of the egg lay is also shown. These records are necessary for the proper interpretation of any other records that may be kept.

Additional records for those who wish detailed information on specific phases of the poultry enterprise:
- Feed, Form 6.
- Labor, laying flock, 8.
- Labor, growing flocks, 9.
- Egg sales, 10.
- Fowl sales, 11.
- Chicken sales, 12.
- Household use, 13.
- Pen records, 14, 15, 16, 17.
- Incubation, 18.
- Notes on management, 19.

Records kept on these forms are suitable for bringing out the details of practice; and with them as guides, poultry keepers can make indicated changes with confidence in the results to be expected.

The troublesome question of the form of the accounts, score cards, or records, is best settled by the individual, as his interest in particular lines of work develops. Any of the following may be kept to advantage without direct reference to the others, but the greatest benefit, with the least work, results from considering any part of the business in its relation to the whole. The receipts may be separated as (1) sales of eggs, (2) sales of poultry, and (3) all other receipts, the total being the cash received. If the receipts from poultry are to be divided, the sum of receipts from sales of chicks, pullets, broilers, and old hens, each kept separate in the record, is brought into final summary as one figure. The feed expenses, which must usually be roughly estimated (for layers, brooder stock, and range stock), can not amount to more than the total feed expense arrived at from the feed bills plus value of home-grown feed

With the occasional counts every poultryman makes, and the quantity factors supplied by sales and purchase records, almost any of the performance records that are published from time to time can be directly compared with the poultryman's own results. These comparisons are distinct aids to improved management. When detailed accounts are kept every care should be exercised to maintain the classification; otherwise confusion follows, and most of the benefit is lost.

INVENTORY

The poultryman's inventory is an itemized list of property on a given date, with the values of each assigned. Form 1 is a condensed inventory sufficient for comparisons of annual growth over a period of years. The counts and descriptions are the important features of the inventory. Large differences in number, quality, or conditions need to be shown by listing the lots separately. For example, all the stock on the place on the inventory day should be counted and appraised; the three classes shown are usually enough. Birds ready to be sold, even if to be sold in the next week, may well be listed separately from those to be kept through the winter, to avoid confusion later. If more than one breed is kept the counts for each breed are worth separate listing, as are specially selected pens of breeding stock from which hatching eggs are expected.

FORM 1.—INVENTORY OF THE POULTRY ENTERPRISE[1]

Item	Beginning of year (October 1)		End of year (September 30)		Change in value	
	Number	Value	Number	Value	Increase	Decrease
		Dollars		*Dollars*	*Dollars*	*Dollars*
Total capital[2]		11, 173		12, 205	1, 250	218
Real estate		6, 600		6, 475		125
Land, acres	20	4, 000	20	4, 000		
Laying house	2	2, 500	2	2, 375		125
Incubator house						
Feed building						
Other buildings						
Other improvements		100		100		
Stock	1, 500	4, 000	1, 800	4, 800	800	
Pullets	1, 000	3, 000	1, 200	3, 600	600	
Hens	500	1, 000	600	1, 200	200	
Males						
Feed on hand, pounds	2, 000	60	1, 000	30		30
Straw and litter, pounds	6, 000	30	4, 000	20		10
Equipment		355		771		34
Incubators			1	450	450	
Brooders	8	240	8	216		24
Watering equipment		20		20		
Cleaning equipment		40		40		
Egg cases and fillers		15		10		5
Shipping crops		15		15		
Miscellaneous		25		20		5
Eggs on hand, dozen	130	78	100	59		19
Miscellaneous supplies		50		50		

---

[1] The figures in this form as well as in the forms that follow, are merely for the purpose of illustrating how the items are put down in the record.

[2] Sum of items shown. The cash balance and the debts of the enterprise must also be considered as significant parts of the inventory, but for ordinary purposes especially on diversified farms, it is not customary to add them to enterprise statements.

Inventory counts and values are intimately connected with the cash account as will appear more clearly later, so that in general the classifications of inventory and cash account should be the same. The first inventory date is the date for beginning all the other records. Most poultrymen find that October 1 or November 1 is the best time to begin the year's accounts.

RECEIPTS AND EXPENSES

Returns from the enterprise can be figured closely only when the multitude of sales, purchases, and payments made during the year are put on paper and added.

Form 2 provides the minimum of information needed for any other purpose than accumulating the totals. Starting with the inventory date, receipts and expenses are set down as they occur. Dates are too important to neglect; they are highly useful in comparing prices and are often indispensable when questions of fact are raised by the other parties to transactions. Quantities are needed in accounting for production, in determining rates, and in planning ahead.

All items must be put into the record separately; otherwise the information for which the accounts are kept can not be obtained except by rough estimate. Lots of eggs sold at different prices may well be written down separately even though sold and paid for on the same day—if condition, size, or customer was a factor worth recalling in explanation of the price difference. Value, divided by quantity, shows the average price; that average price may be enough most of the time, but when grades are a factor each grade sold ought to be treated as a separate lot for record purposes with its quantity, price, and total value. The description of the items should be specific enough to enable one to make desired sortings of the items at a later time.

A page or more of a blank book may be devoted to each month's business. Another modification is to use the book spread open for each month, left page for receipts and right page for money paid out. This form is condensed and simple and is perhaps the easiest for most persons, as there are relatively few transactions to keep in good order.

FORM 2.—DAILY RECORD OF CASH RECEIPTS AND EXPENSES

Month and date	Item	Quantity	Price per unit [1]	Receipt [2]	Expense [2]
			Dollars	*Dollars*	*Dollars*
October 8	Eggs	240 dozen	0.53	[3] 116.10	
October 8	Wheat	1,000 pounds	50.00 T		25.00
October 8	Corn	2.000 pounds	40.00 T		40.00
October 10	Incubator	1	480.00		480.00
October 10	Lumber	500 feet	30.00 M		15.00
October 12	Brooder stove	1	10.00	10.00	
October 13	Eggs	180 dozen	120 @ 0.50; 60 @ 0.38	[3] 75.05	
Total					

[1] Actual price quoted in the transaction.
[2] Net cash at the farm.
[3] Selling costs have been deducted from the face value of the shipment.

Form 3 shows the next logical step, a summary of cash receipts from the different lines for the year. Preferably it should be made up every month, but because all the facts for making it are already in Form 2 or its equivalent it can be made up at any convenient time. The advantage in working it out each month lies in the closer knowledge obtained of the trend of receipts and in the greater opportunity it offers to correct errors which are likely to creep in.

The figures for Form 3 may sometimes be accumulated more easily by taking out of Form 2 all the items that relate to the market egg sales and keeping them together on a separate page, or all the columns may represent details on separate pages.

The expense items really ought to be kept in classes as shown in Form 4, which is a monthly summary of the expenses set down in Form 2 or some modification of it. Seasonal differences in the items appear promptly in this record, and the record also provides basic information for planning ahead, once a farmer has a record for a year or more, for comparison. One is likely to err on the side of too few subdivisions of expense in the current record. Every inclination to combine unlike items in the record should be stifled; small items not needed in later figuring of performance or efficiency may properly be grouped together.

FORM 3.—SUMMARY OF CASH RECEIPTS, BY MONTHS

Month	Eggs		Fowls		Chickens		Miscellaneous	Total
	Quantity	Value	Quantity	Value	Quantity	Value		
	Dozens	*Dollars*	*Number*	*Dollars*	*Number*	*Dollars*	*Dollars*	*Dollars*
October	900	450.00	100	150.00	200	150.00		750.00
November								
December								
January								
February								
March								
April								
May								
June								
July								
August								
September								
Total	1,520	6,080.50	715	905.00	1,310	725.00	225.00	7,935.50

FORM 4.—SUMMARY OF CASH EXPENSES, BY MONTHS

Month	Feed		Labor		Poultry		Miscellaneous	Total
	Quantity	Value	Quantity	Value	Quantity	Value		
	Pounds	*Dollars*	*Days*	*Dollars*	*Number*	*Dollars*	*Dollars*	*Dollars*
October		255.00	4	12.00			490.00	757.00
November								
December								
January								
February								
March								
April								
May								
June								
July								
August								
September								
Total		4,674.36		210.00		750.00	710.00	6,344.36

The difference between cash receipts and cash expenses is only one of a number of measures of returns, and is really satisfactory only when the enterprise is entirely independent of other farm or personal enterprises, when there are no material changes in the inventory, and it is without debts.

Debts and credit transactions that involve two bookkeeping years complicate the bookkeeping. These transactions are matters of financing, necessity, or convenience of the operator as a person. In figuring the earnings from the poultry enterprise for a year, or any of the cost or return factors, precise figuring requires that "cash receipts" be adjusted in one way or another to the sum which would have been received if all sales had been settled within the bookkeeping year, and that "cash expenses" be adjusted to the sum which would have been paid out had all goods and services been paid for in cash on the spot. As money borrowed is not a receipt of the poultry enterprise, the repayment of that money is not an expense of the business. The safest way is to enter in the book all receipts and expenses as they occur; then mark the items that do not belong to the current year's business; and at the end of the year, for purpose of computation, add in the proper amounts for unsettled accounts. Though these adjustments for credit transactions may be about equal at both ends of the year, such separation often clears up questions that would otherwise be obscure. Even with debts and credit transactions allowed for, one or more of the following adjustments must be made, and as size of business is one basis of judging relative success, totals are used rather than balances in the illustrative sample.

The cashbook (Forms 2, 3, 4), shows, for example, a total of $7,935.50 received and $6,344.36 paid out, leaving a balance of $1,591.14. This is sometimes thought of as "the profit for year," but such a balance may be much more or much less than the earnings of the enterprise during the year.

On the income side of the statement the enterprise furnishes eggs and birds to the family which have value; and eggs or birds sold but not paid for, or ready for sale but not yet sold, are earnings of the period just as much as if they had been converted into cash and entered on the book. In case they are not yet sold, one has valuable property instead of money in hand. Increase in the value of the equipment is usually offset by money paid out, so such an increase is not an income item like increase in number of birds or like sales not settled for.

After separation of cash items and addition of noncash inventory and other estimated items the following type of statement results:

Receipts:		
A. Cashbook items (Form 2 or 3)[1]—		
a. Sales of eggs and poultry	$7,710.50	
b. Miscellaneous receipts (sales of equipment, feed sacks, feed, manure, and the like)	225.00	
		$7,935.50
B. Inventory increases (Form 1)—		
a. Stock (and supplies, if any)	800.00	
b. Equipment (and real estate, if any)	450.00	
		1,250.00
(These items are often offset by expense.)		
C. Value of eggs and poultry used by the family (Form 13)		87.00
Total (gross receipts) [1]		9,272.50

Similar inspection of the expense situation promptly suggests that the cash expense total tells only part of the story. First there are the ordinary expenses for feed, hired labor, supplies, and services. Then there are the items paid for but not used up during the year, like the incubator in Form 2, which is offset by the inventory increase in Form 1. Then there may be home-grown feed, which sometimes is a large item of real expense in producing eggs and poultry in a farm flock. Then there may be inventory decreases which should be counted as expense before figuring profit. Sometimes an inventory decrease represents just as real an expense as any for which cash was paid out during the year, and sometimes it represents merely a conversion of property (stock or old equipment), into cash, but in either case receipts must be reduced by the amount before "profit" is figured.

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[1] First adjusted to a basis of cash transactions for the bookkeeping year.

Expenses:		
A. Cashbook items (Form 2 or 4)[2]—		
a. Feed, hired labor, supplies, services, for current use	$5,014.36	
b. Stock, equipment, and improvements to real estate (usually appear in inventory increases unless offset by wear and tear on other items)	1,330.00	
		$6,344.36
B. Inventory decreases (Form 1)—		
a. Stock, feed, straw and eggs	59.00	
b. Equipment and buildings (estimated depreciation)	159.00	
		218.00
C. Home-grown feed, estimated value (Form 6)		525.50
Total (gross expenses)[2]		7,087.86

A review of the year's business, including the inventory changes indicated, the value of home-consumed products, and cash transactions, (cash-for-the-period-basis), shows a difference of $2,184.64 between gross receipts and gross expenses. This sum represents, as nearly as is practicable to determine it, "the return to unpaid labor and to capital," sometimes called operator's "profit." It is $593.50 larger than the balance of the cash items, and though this additional sum was not available for spending in the year of account it was in a form which would yield cash the next year perhaps by sale of birds, perhaps through increased earnings, or perhaps through reduced expenses. The earnings of a business for a specified period may be quite different from the cash sum which the operator of the business may reasonably spend for personal purposes during the year.

The sum "return to unpaid labor and to capital" can be split up as the bookkeeper wishes. In this case, assuming no labor unpaid except the operator's and assuming no debts, the $2,184.64 would pay the operator $100 per month for work done and a little more than 8 per cent interest on the capital value of his property at the beginning of the year. If he figured that he ought to get for his work 50 cents an hour for three hundred and sixty-five 10-hour days ($1,825), the interest on his own capital is reduced to $360 or about 3 per cent. If, moreover, he wants to show a return to management, or true profit, he must decide on a satisfactory rate of interest and an agreeable value for his own services as a physical worker, both of which are to be deducted from the $2,184.64.

Such unlimited choice in the statement of results makes comparisons difficult, but it emphasizes the importance of knowledge of the whole situation for one's own business.

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[2] See footnote 1.

EGG-PRODUCTION RECORD

The daily egg record means much to the observant poultryman as it helps him to see and to measure the changes in production that can be accounted for by changes in feeding practices, weather conditions, or other factors.

Form 5 shows a wall or desk sheet of the daily production of eggs and a summary for the month. The bird count is needed to get the average production for the month, a common measure of performance. An extension of this record is a similar record for pullets separate from the older laying stock, or for special pens, all of which together with the main record make the total egg production for the day. All usable eggs should be counted whether salable or not, in order that eggs per hen, eggs per 100 pounds of feed, or other rates may be figured as closely as possible.

FORM 5.—EGG-PRODUCTION RECORD

Day of month	192–			192–								
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1	600											
2	625											
3	618											
4	622											
5	630											
6	650											
7	695											
8	686											
9	650											
10	700											
11												
12												
13												
14												
15												
16												
17												
18												
19												
20												
21												
22												
23												
24												
25												
26												
27												
28												
29												
30												
31												
Total	18,439											
Number of hens [1]	1,487											
Eggs per bird	12.4											
Per cent production	40											

[1] The exact figure is obtained by using the hen-day basis, in which the number of hens is multiplied by the actual number of days in which they are in the pen and this total is divided by the number of days in the month. A shorter method, and one that is often satisfactory, is to add the number on hand at the beginning of the month and the number at the beginning of the following month, and divide by two. A figure sometimes used, but not recommended, is the number on hand at the beginning of the month.

FEED

Figuring of feed consumption rates and costs, in comparison with egg production and egg prices, is abundantly worth while, as feed is the biggest single item of current cost of egg production and constitutes the larger part of the cost of raising pullets.

Accurate feed records are often difficult to obtain, especially on farms on which the feed used by poultry is not kept separate from the feeds for other farm livestock or on which both home-grown and purchased feeds are used in the ration. One way of bringing feed consumption and costs together on such farms is illustrated in Form 6. In the first column of the form should be listed all of the kinds of feed used by the poultry during the month for which the information is wanted. The home-grown and the purchased feeds should be listed separately. In the second column should be entered the usual quantity fed per day in the ration. The third column is for entering the number of days that the particular feed was used during the month. Current prices for the various feeds are entered in the fifth column. If it is desired to observe the feed cost of egg production for different pens, or for hens and pullets separately, or to observe the feed cost of raising pullets, separate ration reports should be made out for each class of poultry. Care should be taken to see that all the estimates added together approximate the total fed to poultry.

FORM 6. POULTRY RATION REPORT FOR ESTIMATING FEED CONSUMPTION AND COST FOR MONTH OF OCTOBER[1]

Kind and source	Quantity fed per day	Days fed during month	Total quantity	Price per 100 pounds	Total value	
					Home-grown feeds	Purchased feeds
Grain:	*Pounds*	*Number*	*Pounds*	*Dollars*	*Dollars*	*Dollars*
Wheat (purchased)	82.5	31	2,557.5	2.75		70.33
Corn (purchased)	20.0	31	620.0	2.55		15.81
Corn (home grown)	62.5	31	1,937.5	2.40	46.50	
Total	165.0		5,115.0		46.50	86.14
Mash:						
Corn meal (purchased)	52.5	21	1,102.5	2.55		28.11
Bran (purchased)	52.5	21	1,102.5	2.15		23.70
Beef scrap (purchased)	52.5	21	1,102.5	3.90		43.00
Middlings (purchased)	52.5	21	1,102.5	2.15		23.70
Commercial mash	210.0	10	2,100.0	2.40		50.40
Total	420.0		6,510.0			168.91
Other feeds:						
Milk (home grown)	30.0	31	930.0	4.00	37.20	
Cabbage (home grown)	50.0	31	1,550.0	1.00	15.50	
Shells, grit, etc						5.00
Total	80.0		2,480.0		52.70	5.00
Total value all feeds					99.20	260.05

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[1] Similar forms can be used to figure the feed consumption and costs for growing pullets or for individual pens.

The specialized poultryman who buys all his feed can often ascertain his feed consumption and costs with comparatively litttle trouble. He has only to count the sacks regularly and multiply by billed prices. Everything is weighed for him and priced for him so that he needs only to be sure that he does not run the feed for baby chicks, pullets, or cockerels into the feed report for the layers—not if he wants to figure cost of eggs or test out a ration.

The value to be used in figuring cost of home-grown feeds is a matter of indifference so long as it is about that current in the locality. Too high a value reduces the profit shown by poultry, whereas too low a value unduly favors the poultry. Neither has any effect on the profit of the whole business. Jockeying values to make impressions is not only poor business but defeats the purpose for which business records are kept.

Form 7 is a summary of monthly feed quantities and values.

FORM 7.—SUMMARY OF ALL FEED USED BY MONTHS [1]

Month	Grain		Mash		Other Feeds	
	Pounds	*Dollars*	*Pounds*	*Dollars*	*Pounds*	*Dollars*
October	5,115	132.54	6,510	168.91		57.70
November						
December						
January						
February						
March						
April						
May						
June						
July						
August						
September						
Total						

[1] If the laying and rearing flocks are to be studied separately, two feed forms should be used.

LABOR RECORD

Labor is the second largest item of expense of poultry keepers. As such, its importance suggests close study from time to time to find out how effectively the work is done and if something can be done to improve it. Some farmers care for twice as many birds as others with the same amount of labor. Halving the labor cost or doubling the output of the available labor sets up an attractive margin for the operator to work toward.

The labor record may emphasize either of two closely related lines: A time study, which has for its chief object the determination of the best use of the labor available; or a cost study, which is more important in the case of enterprises that use hired labor than in the case of flocks in which all the work is done by unpaid family labor, or in the case of a farmer who wonders whether the poultry enterprise pays as well for the time spent on it as do the cows, hogs, or crops.

For the purposes of the annual summary (Form 3), the labor bill may be estimated at the end of the year. The value of family labor has to be estimated rather arbitrarily at a figure comparable with the wages and work accomplished by hired labor; or else the total return left for family labor may be figured as the sum left over after all other charges are deducted, from which the wage rate earned by unpaid labor is computed by dividing the sum so reached by the time worked by the owner and his family.

A summary labor record for the laying flock is given in Form 8. One day a month the time spent on regular daily work (chores) is observed closely. This includes all items—feeding, watering, cleaning pens, opening and closing pens, gathering eggs, and the like. The daily time, multiplied by the number of days, gives the time spent during the month. Time spent in marketing and preparing eggs for market may be similarly estimated. "Other" work includes the occasional jobs like repairing fences, unloading a truck of feed, or culling the flock. This occasional work may be estimated as a total for the month unless some kind of work of that description is done nearly every day. The form provides for the separation of the work done by hired labor. If from the totals for the year the time worked by hired labor is subtracted, the result gives the time worked by the owner and his family, which time may be valued at the same rate per day or at any other rate that may seem best.

Similar records may be made for any other subdivision of the flock for which a time record is wanted. (Form 9.) In this connection as before, the estimates for any part of the flock should be compared with the total labor on the whole flock so that the estimates may be kept within the bounds of reasonable fact. When the number of birds in a lot changes materially the numbers cared for in each period should be noted, so that labor per 100 birds (or other unit) may be figured. The ideal of a uniform figure per bird each month, in spite of changes in number, can seldom be reached, but failure of the figures to approach a uniform figure indicates time available for other more profitable effort.

FORM 8.—LABOR REPORT—LAYING FLOCK

Month	Kind of work	All labor			Hired labor				
		Hours per day	No. of days	Total hours	Hours per day	No. of days	Total hours	Rate per hour	Total value
October	Daily chores	8½	31	248	9	2	18	40¢	$7.20
	Mktg. & prep. for mkt [1]	1½	31	46½					
	Other	½	31	15½					
November	Daily chores	7	30	210					
	Mktg. & prep. for mkt	2	30	60					
	Other	1	30	30					
December	Daily chores	7½	31	232½					
	Mktg. & prep. for mkt	1½	31	46½					
	Other	1	31	31					
January	Daily chores								
	Mktg. & prep. for mkt								
	Other								
February	Daily chores								
	Mktg. & prep. for mkt								
	Other								
March	Daily chores								
	Mktg. & prep. for mkt								
	Other								
April	Daily chores								
	Mktg. & prep. for mkt								
	Other								
May	Daily chores								
	Mktg. & prep. for mkt								
	Other								
June	Daily chores								
	Mktg. & prep. for mkt								
	Other								
July	Daily chores								
	Mktg. & prep. for mkt								
	Other								
August	Daily chores								
	Mktg. & prep. for mkt								
	Other								
September	Daily chores								
	Mktg. & prep. for mkt								
	Other								
Total	Daily chores								
	Mktg. & prep. for mkt								
	Other								

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[1] Marketing and preparation for market.

FORM 9.—LABOR REPORT—GROWING FLOCK

Month	All labor			Hired labor				
	Hours per day	Number of days	Total hours	Hours per day	Number of days	Total hours	Rate per hour	Total value
							Cents	*Dollars*
March	6	31	186	2	31	62	40	24.80
April	5	30	150	1	30	30	40	12.00
May	4	31	124					
June								
July								
August								
September								
Total								

SALES RECORDS

Sales records are records in which the receipts are kept in greater detail than is usually considered necessary for preserving in the record of receipts. (Form 2 or 3.) When sales are numerous, because different outlets may pay different prices or may offer different terms, a thorough analysis of all egg sales should be helpful in deciding the best markets for the eggs. When a decision is reached, the detail may perhaps then be dropped. In practice, if duplicate sales slips are made out or received in settlements, these slips constitute the sales record. They may be sorted in order to put together all that are alike, and then all the different piles are summarized for the permanent record before the slips are destroyed. Several sortings may be made—by grade, by price, by method of sale, by firms to which sales are made, by customer, or by market. Forms 9, 10, and 11 show basic information about sales for eggs, for fowls, and for chickens. Other information that can be obtained by modification of the form or by supplementary computations will occur to the poultryman who begins to use the form.

Among the readily available summaries from the egg-sales record are quantities sold weekly or monthly (sometimes called seasonal distribution of production); average prices, and seasonal movement of prices; total received for eggs; check-up on payment for eggs shipped; difference in price of the grades (if eggs are graded at the farm); and cost of marketing, if the transportation and selling charges are noted in addition to the net price and net value. A column might be added to show the quoted price in one or two markets to which the eggs might have been sent, for comparison with the price actually returned by the firm to which the eggs were sent. Comparison of the total eggs sold with the total produced (daily egg record added, Form 5), may occasionally be made to advantage as a check on home use and breakage. The poultryman is accustomed to turning over in his mind all of these points of management. The record assures definiteness of the ideas, whereas memory may not reliably provide the information, especially for comparisons with past seasons.

Sales of fowls should be kept separately from sales of chickens or broilers. Market seasons are distinct, conditions different. Running the receipts from these two classes of stock together, or bunching receipts from poultry and eggs together, means sacrificing much of the benefit that might be gained from keeping the record.

FORM 10.—RECORD OF EGGS SOLD[1]

Shipment				Settlement					
Date	Destination	Dozen	Grade or description	Date	Dozen	Grade or description	Price per dozen	Express, commission, etc.	Net cash
							Cents	*Dollars*	*Dollars*
Oct. 8	M & Co. N. Y. City.	240	Extras	Oct.15	240	Extras	53	11. 10	116. 10
Oct. 13	J & Co. Phil.	180	Ungraded	Oct.16	120	Extras	50	5. 40	54. 60
				Oct.16	60	Small	38	2. 35	20. 45

[1] Use one line for each sale.

FORM 11.—RECORD OF FOWLS SOLD[1]

Shipment				Settlement				
Date	Destination	Number	Total weight	Date	Total weight paid for	Price per pound	Express, commission, etc.	Net cash
			Pounds			*Cents*	*Dollars*	*Dollars*
Jan. 10	C & Co. N. Y. City	100	424	Jan. 17	410	24	14. 50	83. 90
Jan. 25	" " "	54	220	Feb. 2	218	25	8. 15	46. 35

[1] Use one line for each sale.

FORM 12.—RECORD OF CHICKENS SOLD[1]

Shipment				Settlement				
Date	Destination	Number	Total weight	Date	Total weight paid for	Price per pound	Express, commission, etc.	Net cash
			Pounds			*Cents*	*Dollars*	*Dollars*
July 1	K & Co. N. Y. City	300	450	July 8	448	30	18. 10	116. 30
July 12	K & Co. N. Y. City	275	420	July 15	402	28	16. 50	96. 06
July 20	K & Co. N. Y. City	200	390	July 28	390	26	15. 10	86. 30

[1] Use one line for each sale.

RECORDS OF EGGS AND POULTRY FOR HOUSEHOLD USE

The value of eggs and poultry furnished to the farm family by the poultry enterprise is often an important factor in poultry returns, especially on farms where the flocks are small. One way of keeping a record of this information is shown in Form 13. In some cases the poultry products used can be estimated closely enough and entered in the form at the end of each month.

FORM 13.—RECORD OF EGGS AND POULTRY FOR HOUSEHOLD USE

Month	Eggs			Fowls			Chickens		
	Quantity	Price per dozen	Value	Quantity	Price per head	Value	Quantity	Price per head	Value
	Dozen	*Cents*	*Dollars*	*Number*	*Cents*	*Dollars*	*Number*	*Cents*	*Dollars*
October	15	30	4.50	4	75	3.00			
November									
December									
January									
February									
March									
April									
May									
June									
July									
August									
September									
Total	200		43.00	40		32.00	30		12.00

PEN RECORDS

Whenever the flock is sorted into pens by age, breed, condition, or heredity, a pen record is a distinct help in judging the performance of the pen with respect to eggs produced, weight gained, or feed consumed. If the main object is merely mechanical separation to prevent crowding the pen record is a help in checking numbers. Actual counts then need to be made only for checking purposes at convenient times.

Starting with the number in the pen at inventory time (or when the pen is made up), the numbers added are set down in one set of columns, and the numbers transferred, sold, used at home, or lost by death are set down in another set of columns. (Forms 12, 14, 15.) Thus at any time the exact number of birds in the pen may be figured, and this number should check with the count of birds actually in the pen at that time. Of course, if fences are not tight or if chickens escape into adjoining pens, the pen record will not check with the count, but the addition of all the pen records will still yield useful information about the numbers of birds in the flock and what disposition was made of them.

The pen records, separately and added together, provide the information to be used in connection with Form 5 to get the percentage production; with Form 6 for figuring the feed consumed per bird or per dozen eggs; with Form 8 for figuring the labor used; with Forms 10, 11, 12 for checking the relative values of eggs, fowls, and chickens. Poultrymen who have kept flock records of this kind find that a card tacked in the pen is convenient. They also emphasize the value of setting down the mortality and the reasons for the deaths. The other disposal items can be obtained from other records for the flock as a whole, though it is often convenient to specify disposition on the pen record and it is always necessary when performance by the pen is to be figured out.

At the end of each month it may often be desirable to summarize the pen information for the purpose of observing monthly or seasonal changes in numbers of layers, chicks, or pullets on hand. Such a summary is shown for the laying flock in Form 17. Summaries for the brooding and rearing flocks can be made in the same way.

FORM 14.—PEN RECORD, LAYING FLOCK

PEN NO. 4:[1] BREED, WHITE LEGHORNS, PERIOD, OCTOBER, 1928–MARCH, 1929

Item	Oct.	Nov.	Dec.	Jan.	Feb.	March
Number on hand first of month	500	488				
Number died, missing, or stolen during month	(12)	(4)				
Principal causes of losses	Roup	Unknown				

DISPOSALS, ADDITIONS, AND COUNTS

Date	Sales, transfers, and used in home		Date	Additions and purchases		Counts, and dates for same [2]
	Number	Disposition		Number	Source	
Jan. 10	20	Hens sold	Nov. 22	30	From Pen 4	Date *Dec. 1*
Jan. 20	2	Home use				*Number 512*

[1] All the pen records added together give the flock record.
[2] The counts are made for checking purposes at convenient times.

FORM 15.—PEN RECORD, BROODER CHICKS

PEN NO. 1: DATE STARTED, *MAR. 29*, NUMBER STARTED *1400*, BREED, *W. LEGHORNS*

MORTALITY AT VARIOUS AGES—AGE IN WEEKS

	1	2	3	4	5	6	7	8	9	10	Total
Number died during week	28	26	15								
Principal causes	Weak Chicks	Weak Chicks	Cold weather								

DISPOSALS, ADDITIONS, AND COUNTS

Date	Sales, transfers, and used in in home			Date	Additions and purchases			Counts, and dates for same
	Number	Pullet or cockerel	Disposition		Number	Pullet or cockerel	Source	
May 30	300	Cockerels	Market	May 15	20	Cockerels	J. Brown	Date *June 1* Number *1051*
June 5	600	Pullets	Range					Date *July 1* Number *350*

FORM 16.—PEN RECORD, PULLETS ON RANGE

RANGE NO. 1: DATE JUNE 5, NUMBER STARTED 600, BREED, *W. LEGHORNS*

Mortality at various ages—Age in months

	3	4	5	6	Total
Number died, missing, or stolen during month	11	1			
Principal causes	Hawks.	Skunks.			

DISPOSALS, ADDITIONS, AND COUNTS

Date	Sales, transfers and used in the home		Date	Additions and purchases		Counts and dates for same
	Number	Disposition		Number	Source	
July 1	25	Sold as culls	June 15	20	J. Brown	Date July 5 Number 865
Aug. 24	100	Sold for layers	July 1	300	Brooder No. 3	Date ——— Number ——

FORM 17.—SIZE OF LAYING FLOCK FIRST OF MONTH AND CHANGES IN SIZE DURING MONTH[1]

Month	On hand beginning of month	Purchases and additions	Sold		Home use	Died
			Market	Breeders		
	Number	*Number*	*Number*	*Number*	*Number*	*Number*
October	1,500		50		5	20
November	1,425					
December						
January						
February						
March						
April						
May						
June						
July						
August						
September						
October [2]	600					
Total	[3] 16,250		705	10	40	145

---

[1] This record should not include pullets added to the flock at the end of the year.

[2] This second October 1 inventory is needed for the purpose of taking care of the flock changes in September, in order to complete a years record.

[3] Dividing this total by 13 gives an approximate figure for the average size of the flock for the year.

INCUBATION AND HATCHING RECORDS

The principal items to be included in a properly kept record of incubation are given in Form 18. If the operator makes a business of selling day-old chicks it would be well to add another column to show the disposition of the chicks hatched—whether they were sold or kept on the farm.

FORM 18.—INCUBATION RECORD

Date set	Eggs set	Breed	Source or class of eggs	First test		Second test	Chicks hatched	Percentage hatched of all eggs set
				Infertile	Dead germs	Dead germs		
	Number			*Number*	*Number*	*Number*	*Number*	*Per cent*
Mar. 7	2,000	W. Leg	Own flock	200	100	40	1,400	70
Mar. 14	2,500	W. Leg	J. Jones	200	100	50	1,775	71
Mar. 21	2,000	R. I. Red	H. Brown	240	120	60	1,300	65
Total								

DIARY OR NOTES ON MANAGEMENT

Many experienced poultrymen make a practice of setting down on paper significant notes on important events—weather, changes in practices, and the like—which are related to their management of the flock. Such a record may be in the form of a printed diary which can be purchased, but a blank book serves every need and is more flexible in space utilization. (Form 19.) The date of the observation is important. The nature of the items to record is a matter of possible later interest. Days may pass without occasion for writing in the diary; then many things of permanent interest may happen. Some men use the diary for describing the terms and condition of sale, forecasts of returns, comment on markets, and other phases of management previously suggested in connection with the several forms. Convenience of the poultryman controls, but general usefulness suggests, the record of all comment with the form to which it applies. The principle is that the records kept should together provide the poultryman with the facts he needs in figuring results of past efforts and in planning for the future.

FORM 19.—NOTES ON MANAGEMENT

Date	Remarks
October 15	Started lights on pullets, mornings and nights, 13-hour day.
October 15	Started to feed cod-liver oil to layers, 1 quart per 100 pounds of mash.
October 16	Cold, rainy weather.
October 17	Pullets confined for winter.
October 19	Closed all rear openings in houses.
October 21	End of cold, rainy weather; birds came through in good shape, no colds.

MAKING USE OF THE RECORDS

Although the mere keeping of records, a few or many at a time, is of some small benefit, the full fruits of the work done are not to be gathered until the records are used to answer questions of policy and practice.

Poultry keepers who have difficulty in analyzing and making use of their records may be helped by considering the following method of procedure.

1. **Summarize the important factors of price and production.**—A partial set of the factors of price and production is offered for example in Form 20. All of these may be figured from the forms suggested. The form provides a permanent record of the accomplishments in each of three years. Other factors of special interest can be added at will. All need not be used. A summary table of this kind provides a good basis for beginning an analysis of price, production, and other factors which may have affected poultry earnings during a given period.

FORM 20.—SUMMARY TABLE OF IMPORTANT FACTORS IN POULTRY-FARM MANAGEMENT

Item	Information brought forward from form numbers	1928–29	1929–30	1930–31
Egg production per hen and marketing practices:				
Eggs laid—				
Oct.-Dec. Number	5, 14, 17			
Jan.-Mar. do				
Apr.-June do				
July-Sept. do				
Total for year do				
Per cent of eggs graded as "Extras" Per cent	10			
Feed per bird:				
Grain, laying flock Pounds	6, 7, 14, 17			
Mash do	do			
Grain, rearing do	6, 7, 15, 16			
Mash, rearing do	do			
Labor:				
Labor per 100 fowls—				
In laying flock Hours	8 & 17			
Pullets raised do	9 & 16			
Costs:[1]				
Cost of grain per 100 pounds—				
Laying flock Dollars	6 & 7			
Mash do	do			
Grain, rearing do	do			
Mash, rearing do	do			
Feed cost per dozen eggs produced Cents	5, 6, 7			
Returns:				
Price received for —				
Eggs, per dozen do	10			
For fowls per pound do	11			
Broilers per pound do	12			
Mortality:				
Laying flock Per cent	14, 17			
Brooder flock do	15			
Pullets on range do	16			
Chicks hatched in per cent of all eggs set do	18			
Pullets raised per 100 chicks started Number	15, 16			

[1] See notes at bottom of Forms 5 and 6.

2. **Study the price factors.**—Prices received for eggs, fowls, and broilers, and prices paid for feed and other important poultry items have an important effect on poultry earnings. These prices have varied considerably during past years, often causing wide fluctuations in net returns from poultry farming. For a given period feed prices may be high or low in relation to egg prices, or prices of poultry meats may be high or low in relation to egg prices, or the spring and summer, (storage season), price of eggs may be high or low in relation to the fall and winter price, and so on.

It is important to study the records and other sources of information to find out what the price relationships were for the period covered by the records. These relationships should then be compared with similar data for other years. Price information for these comparisons can be obtained from the records of previous years for the same farm and from price quotations published in trade papers, in the Yearbook of the United States Department of Agriculture, and in other reliable publications.

The county agent, the State college of agriculture, or the United States Department of Agriculture will furnish poultrymen with price data that will enable them to know price trends for poultry and other farm products. Information of this kind is used by successful farmers in planning increases or decreases in the different lines of production and in planning feeding and other practices that are likely to be most profitable under the conditions that are expected to prevail. Farmers should compare their own prices and price trends with those for their locality or for the leading markets. This will enable them to know whether the prices they received were higher or lower than the market level, and may possibly suggest means for improving the price relationships for their farm production the following year. Perhaps it will be found that prices received for poultry products can be improved by a close study of marketing requirements or by having more eggs to sell during the fall months.

3. **Study the production factors.**—Among individual farmers there often is wide variation in the seasonal and annual production of chickens on farms, in the amount of labor used in poultry farming, and in the mortality of chicken flocks. Although extreme changes in weather conditions affect the average egg production, health, or mortality of most flocks in a section, it has been demonstrated that some poultrymen are able to obtain good production results from their flocks in spite of adverse conditions. This is an important factor in the success of many poultry keepers.

The production factors in the summary table should be studied to determine where opportunities exist for improving or raising the production standards. Perhaps it will be found that the egg production for the year was low or that not enough eggs were produced during the winter months. Perhaps culling was neglected, and too many poor layers were kept on high-priced feeds, or perhaps too few pullets were saved per 100 chicks started.

4. **Select factors that offer best opportunities for improvement and plan to carry them out.**—Careful study of the records will probably reveal some things that offer better opportunities for improvement than others. These exceptional opportunities should be given further study and thought, for the purpose of making plans to put them into practice. The value of records will depend largely on the improvements made in the weaknesses that are revealed by the records.

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December 5, 1929

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HAY STACKERS AND THEIR USE

By L. A. Reynoldson, *Associate Agricultural Economist, Division of Farm Management and Costs, Bureau of Agricultural Economics*

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INTRODUCTION

HAY STACKERS enable the farmer to handle a given quantity of hay more rapidly than by other methods, and under most conditions a smaller crew is required.

Some types of hay stackers used on farms in the Corn Belt and Western States could be used to advantage on many farms in the Eastern and Southern States on which stackers are seldom used, but on which the hay is stacked. In some sections of the Corn Belt and Western States, it is possible that better types of stackers could be used than those that are now common.

Many eastern and southern farmers have tried stackers but some have abandoned them, owing partly to inexperience and partly to difficulty in getting their men to give them a fair trial. Some farmers have tried out light and cheaply constructed stackers not suited to their conditions. Other farmers, who have been in the habit of making small stacks containing from 1½ to 3 tons, have not attempted to use stackers because they think that hay will not keep in the large stack that is usually made with a stacker—an objection not based on facts. Large stacks tend to reduce loss caused by weathering. Putting hay into a barn or shed is preferable to stacking in these regions, and when hay is stored under cover it is often possible to use certain types of stackers. This bulletin describes the different types and styles of stackers, their cost, conditions favorable for the use of the different types and styles, the size of the stack that can be built with each, and the size and duty of various crews.

Hay stackers may be divided into four general types, according to the way they handle the hay. One type is represented by the "overshot" the "swinging" and the "combination" stacker. Each of these has long wooden teeth, like those of a sweep rake. The sweep rake drops its load of hay directly on these teeth which in turn elevate it to the stack.

A second type is represented by the homemade slide stacker and plunger. The entire stacker is constructed of long poles, those forming the slide being placed at a 45° angle. A sweep rake delivers its load at the bottom of the stacker and a plunger with a heavy frame on the front, operated by a team pushes the hay up the slide and onto the stack.

The third type of stackers represented by the cable and derrick outfits do not receive hay directly from sweep rakes but handle it by means of horse forks or slings. The material used for their construction is usually assembled on the farm.

The fourth type is used only to a limited extent. This type uses ropes to elevate the hay to the stack. Compared with other types it is simple and requires little if any cash outlay for equipment.

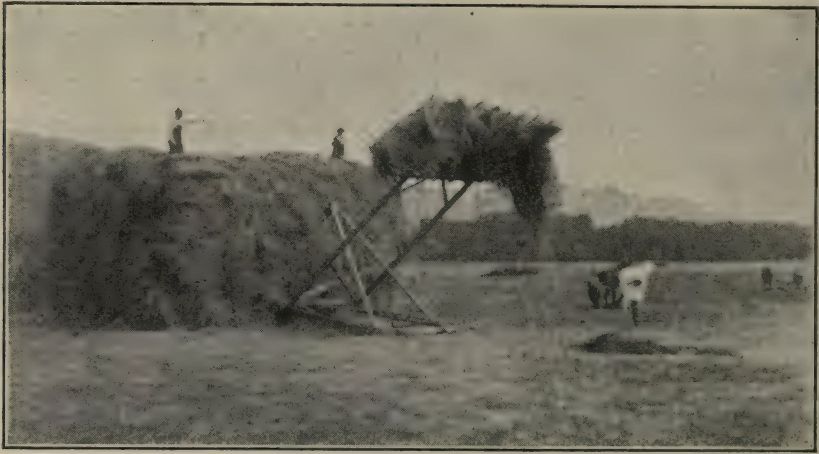

FIGURE 1.—A common style of overshot stacker which is widely used. Two or three sweep rakes can be used with this outfit

OVERSHOT STACKERS

The overshot stacker (fig. 1) is so called because the hay is carried up and over the stacker frame and is delivered at one point on the stack. This necessitates considerable moving of hay by hand when the stack is large.

Nearly all stackers of this type are constructed of wood. In most instances the stacker is mounted on a heavy frame which serves as a sled to move the stacker from place to place. Some of these stackers are made of extra-heavy material for use where large acreages of hay are put up, and it is customary to load them heavily. A lighter and cheaper type is available for small farms and gives satisfactory service if the loads handled are not too heavy.

One style of overshot stacker is made with an inclined front (fig. 2), up which the head carrying the hay, mounted on small wheels, travels to the top, whence the hay is dumped on the stack.

A device, consisting of springs or weights that counterbalance the weight of the stacker head while the latter is returning to the ground after the hay has been dropped on the stack, is a very desirable feature. Without it the team must be backed slowly, holding the weight of the empty head until it reaches the ground. This causes loss of time and lessens the capacity of the stacker.

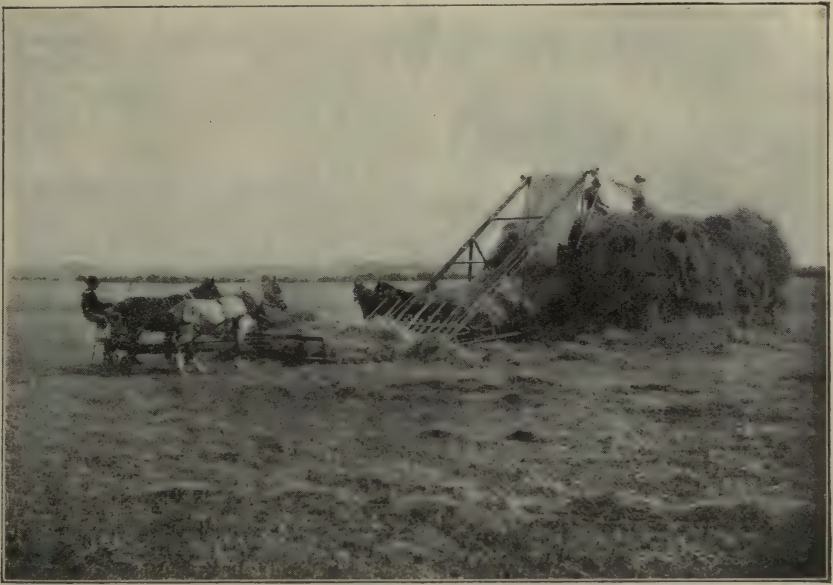

FIGURE 2.—Stacking hay with an inclined front overshot stacker mounted on wheels. Two or three sweeps are used with this outfit. With this style of stacker nearly all the heavy hand work is eliminated

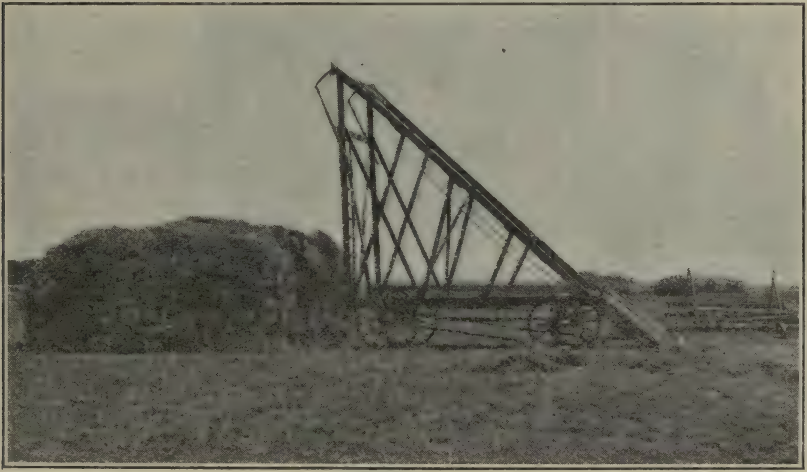

FIGURE 3.—An inclined front overshot stacker mounted on wheels, which makes it easy and quick to move to a new set

Some styles of the overshot stacker can be mounted on wheels which allows the stacker to be easily and quickly moved. Often the running gears of an old wagon or truck will be satisfactory for this purpose. (Fig. 3.)

When putting up wild hay with an overshot stacker, it is possible to save the labor of one man on the stack by using a contrivance called a "frontboard and backboard." In some wild-hay districts extensive use is made of this device of which there are several styles.

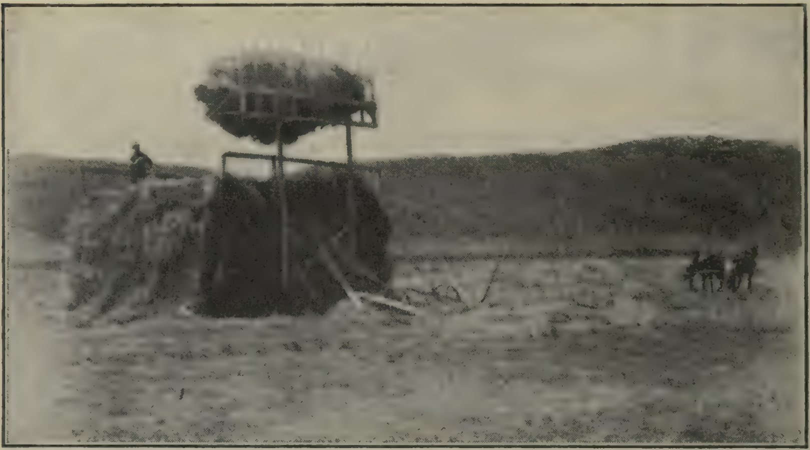

FIGURE 4.—The frontboard and backboard in use with an overshot stacker in stacking wild hay

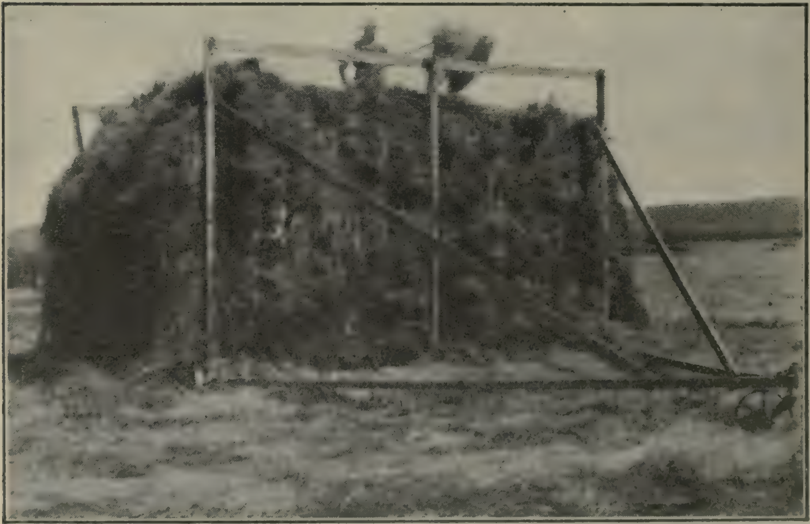

FIGURE 5.—The backboard, the setting of which regulates the width of the stack. A stake driven in the ground, and to which the caster wheel in front is attached by a chain, prevents the backboard from moving

The frontboard (fig. 4) is attached to the stacker, whereas the backboard (fig. 5) is built on wheels or shoes so that it can be easily moved about the hayfields. By using this device the front and rear of the stack can be built without much work on the part of the stack man. He must merely walk along the sides of the stack and force the hay down so it will shed water. The ends, being open, are handled in the usual way. This method of stacking enables one man on the stack to handle a quantity of hay which ordinarily requires two men.

Frames for the frontboard and backboard should be 10 to 12 feet high and about 18 feet long and made of 2 by 6 inch lumber. Smooth, heavy wire is stretched up and down the frame at about 1-foot intervals. Boards may be used in place of the wire, but they increase the weight, and breakage is more frequent.

The cost of an overshot stacker depends upon the style and construction. The cheapest of these stackers may be bought for about $75; the more expensive outfits range up to about $125.

The overshot stacker is well adapted to building stacks of different size and is perhaps more popular with the average hay grower than is any other type. It can be used with either a small or a large crew and, when mounted on wheels, can be moved to a new stack site in a few minutes with hardly any loss of time on the part of the crew. With this outfit stacks ranging up to 30 tons or more can be built.

For stacking alfalfa or mixed hay most crews consist of five men. The hay is brought into the stacker by two sweep rakes. Two men stacking the hay and a man or boy to drive the stacker team, as in Figure 1, complete the crew. From 30 to 40 tons of hay are stacked by this crew in one day.

In localities where wild hay is put up and the frontboard and backboard are used with the overshot stacker a crew of five men is ordinarily employed. Two sweep rakes are used to haul the hay to the stacker from the windrow. One man on the stack, a man or boy to drive the stacker team, and a man to rake the scatterings complete the crew, which puts up about 32 tons of hay daily. By adding two sweeps to the crew about 60 tons of hay are put up daily. To handle this quantity of hay the man on the stack should be relieved by changing places with other members of the crew.

The smallest possible crew for this method is composed of one man on the stack, a boy to drive the stacker team, and one man with a sweep rake. This crew will put 10 to 15 tons in the stack a day. This size of crew is not as economical as the larger crews, but it handles hay more rapidly than a 3-man crew can, following any of the methods in which hand labor is used.

SWINGING STACKERS

The swinging stacker (figs. 6 and 7) has a head for carrying the hay which swings sidewise and upward instead of vertically, the hay sliding off the ends of the teeth when being deposited on the stack. Otherwise it is somewhat similar to the overshot type. The principal advantage of the swinging stacker over the overshot is its ability to deliver the load of hay to different parts of the stack, thus reducing the amount of work required on the stack.

With some styles of swinging stackers it is possible to load from either side at the will of the operator, so that the sweep rakes do not interfere with each other as much as when using other types. With a good operator, this stacker has perhaps greater capacity than any other type for as many as six or eight sweep rakes can be used with it. In the hands of a poor operator it is an unsatisfactory type to use.

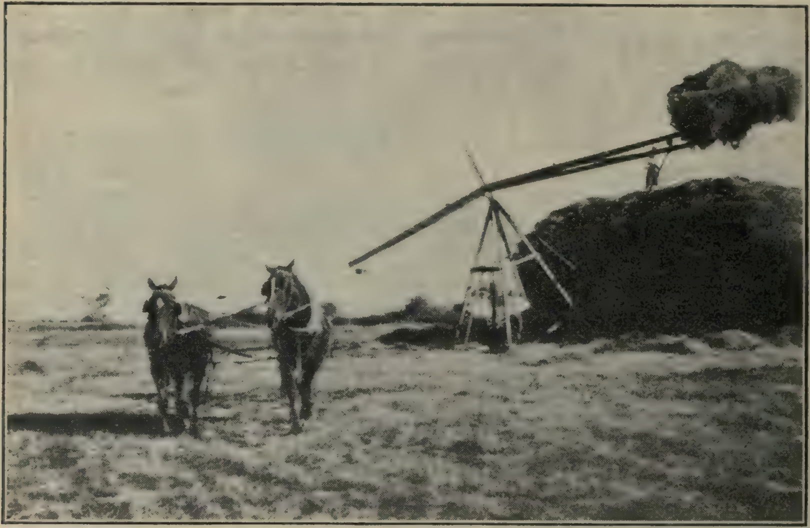

FIGURE 6.—A swinging stacker ready to drop its load on the stack. This outfit takes a load from either side and can be set to drop the hay at different points on the stack. As many as eight sweep rakes can be used with this style of stacker

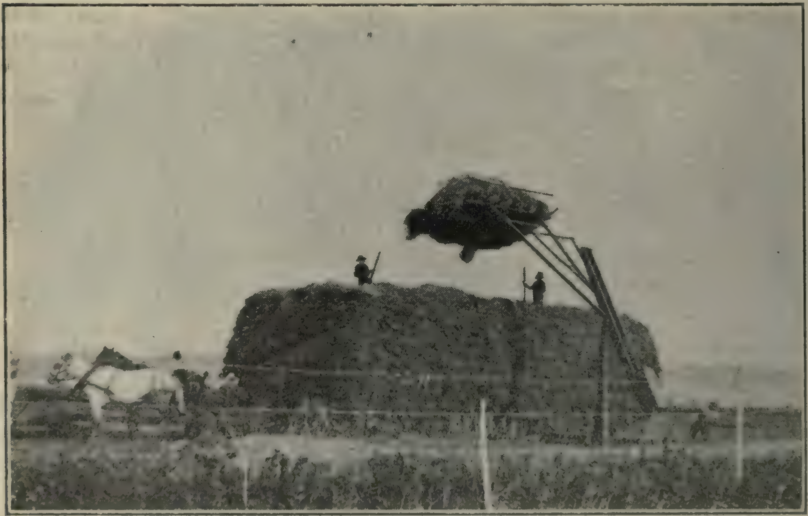

FIGURE 7.—This style of swinging stacker has a weighted box on the lower end of the swinging arm to counterbalance the weight of the head. With this style the load has to be tripped by hand

These stackers, like some of the overshot outfits, are too lightly constructed for use when heavy loads are handled.

The cost of this style of stacker is about the same as that of the overshot outfits.

With the swinging stacker, the same sizes of stacks can be made as with an overshot, and this stacker has the same advantage that the overshot has, namely, it can be used with a small or a large crew. But it can not be moved as quickly as can the overshot stacker that is mounted on wheels.

When speed is necessary, a larger crew can be used with a swinging stacker and more hay can be put up than with any other stacker of this type. About the maximum crew for a swinging stacker which loads from both sides is made up of 6 men on sweep rakes, 2 men on the stack, 1 man driving the stacker team, 1 man raking scatterings, and 1 clean-up man around the stack. The stacker loads first from one side and then from the other, so that three sweeps operate from each side, thus avoiding confusion around the stack. A crew of this size can put up from 80 to 100 tons daily.

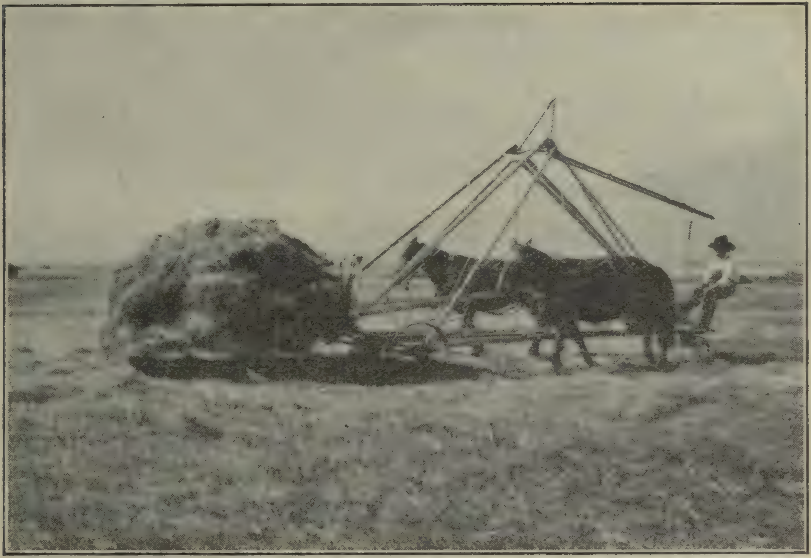

FIGURE 8.—A loaded combination stacker. The hay is sometimes taken from the windrow by the stacker, but more often is delivered to the stacker by sweep rakers

COMBINATION STACKERS

A combination of sweep rake and stacker does the work of both. This style of stacker is mounted on wheels and operates by being driven over the ground. An elevating mechanism is engaged when the stacker is about 80 to 100 feet from the stack, and the rake with its load is then lifted, as the stacker advances, until it is high enough for the load to be deposited upon the stack. (Figs. 8 and 9.)

The combination stacker can be used to take the hay from the windrow, swath, cock, or sweep rake, and place it on the stack in the same way as does the overshot stacker, but with the combination stacker the hay can be placed on any desired part of the stack. (Fig. 10.)

It can be used to advantage to load hay from the windrow or cock on wagons when labor is scarce, or when the distance is too great to haul the hay with the stacker or the sweep rake. Its most common use is near the stack, where it handles the hay brought in by sweep rakes. When starting a new stack with this style of stacker, no time is lost in moving or setting the outfit. In building a stack, the hay can be placed at either end or at either side, this allowing a change of

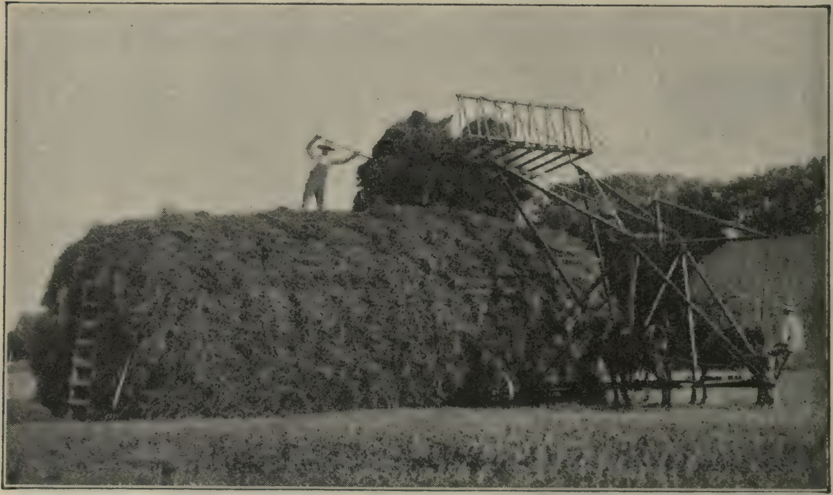

FIGURE 9.—The combination stacker putting hay on the stack. It can place the hay on the stack from either side or from the end, and the direction of the wind does not affect its usefulness in the least. Stacks a little more than 20 feet high can be made with this outfit

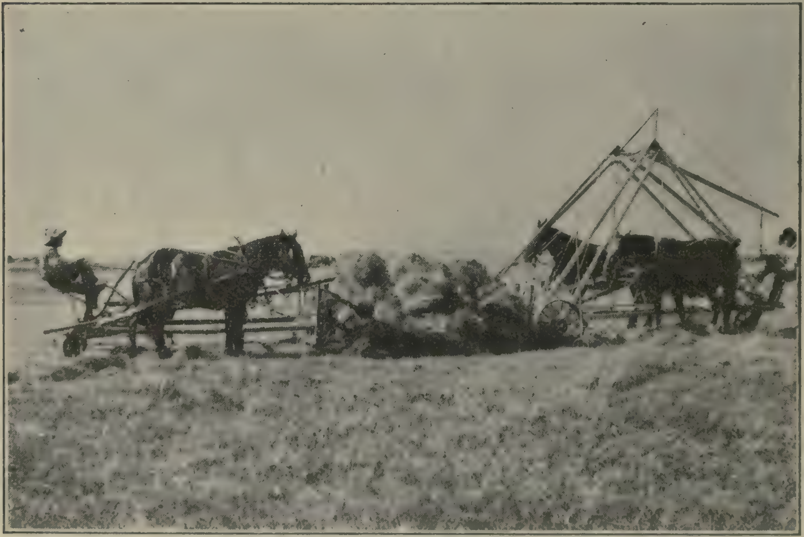

FIGURE 10.—Loading a combination stacker with a sweep rake, with hay taken from the cock or windrow. In the case of long hauls or on rough ground this is the best method of using a combination stacker

position if the wind shifts during the stacking operation. This stacker, in comparison with others, has a rather low daily capacity, together with a higher first cost. When used to bring in hay from the windrow or cock in meadows that are rough and uneven, because of its excessive weight, this outfit is hard on the team and does rather unsatisfactory work.

The cost of a combination stacker is somewhat higher than that of either the overshot or swinging style.

Stacks of any desired length can be made with the combination stacker without necessitating any extra labor on the stack, because with this stacker hay can be placed on any desired part of the stack, from either side or either end. It can be used to build very small stacks as easily as long ones. The extreme height of stacks made with the combination stacker is from 20 to 23 feet. The tonnage of hay in stacks built with a combination stacker is dependent upon the length of the stack made at each setting.

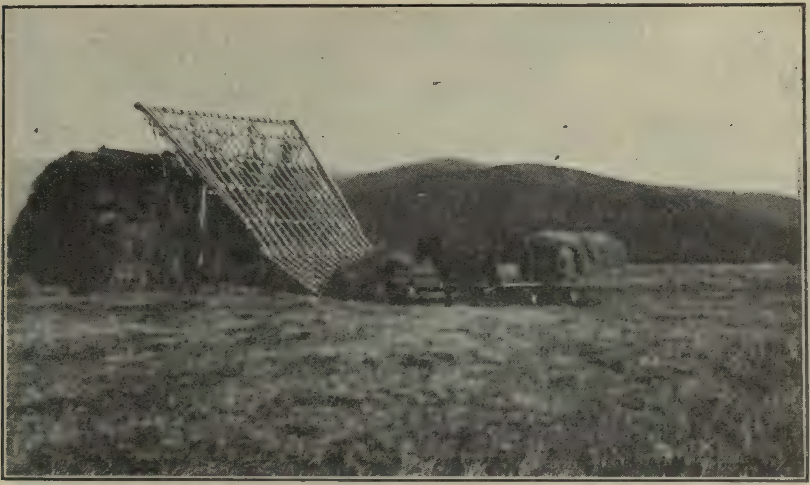

FIGURE 11.—A sweep rake delivering a load of hay at the base of a fan-shaped slide stacker. When the sweep is backed away the hay is shoved up the slide by a plunger

A crew consisting of 1 man on the combination stacker, 3 men on sweeps, 1 man on the stack, and 1 to rake scatterings, will put up 35 to 40 tons per day. Only 1 stack man is necessary as the stacker delivers hay to any desired point on the stack and the sweeps deliver the hay to the stacker. (Fig. 10.)

SLIDE STACKERS

The slide type of stacker, which is a homemade outfit built like a slide, is constructed entirely of poles from which the bark and all rough spots have been removed, or is made from smooth boards and timber and mounted on slides. A plunger which elevates the hay completes the outfit.

Three styles of this stacker are in use. The first, which is perhaps the most efficient, is fan shaped, being wider at the top than at the bottom (fig. 11); the second is the same width throughout; and the third has a solid slide built of smooth boards.

In the pole styles the lower 6 feet of the slide is usually constructed of movable sections of six to eight teeth each. These sections can be lifted and shoved back into the body of the stacker, when it is moved to a new set. The poles on the remainder of the slide are continuous. Most slides have a guard rail on each side to prevent the plunger from running off when the hay is being elevated.

The elevating device consists of a plunger (fig. 12), constructed of a pole about 35 feet long, on the front of which is a heavy frame of poles or timber about 12 feet wide, 3 feet high, and 12 to 16 feet long, mounted on two wooden rollers to reduce friction. The team is hitched to a doubletree attached by a swivel on the opposite end of the pole. This allows the team to be turned around when the plunger is pulled back for each load.

The use of pole slides is rather closely confined to certain localities in Colorado where a large tonnage of wild or mixed hay is stacked with them. The other style is used in sections along the Pacific coast.

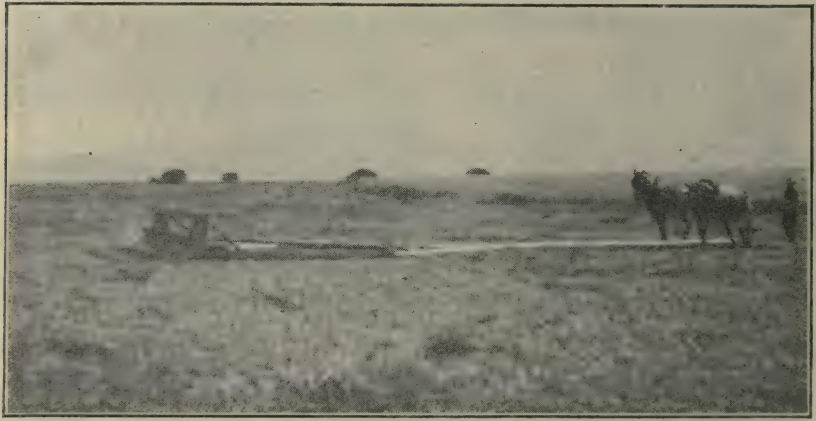

FIGURE 12.—The plunger used with the slide stacker to push the hay up the slide onto the stack

With this type of stacker, hay is delivered at the base of the slide as in Figure 11. The plunger is then started forward as in Figure 12, and pushes the hay up the slide and onto the stack as in Figure 13. By driving the team at different speeds the hay can be made to fall either at the front or the back of the stack. With the fan-shaped slide large stacks are more easily built than with the other styles, as the plunger driver can deliver hay near either end of the stack, which saves the stack men a large amount of work.

As these stackers handle large quantities of hay very rapidly, two or three men are usually required on the stack. A heavy team is needed on the plunger, which together with the hay makes a considerable load.

As these stackers are homemade outfits, the cost is only a few dollars if the poles are cut on the farm or obtained from near-by woods. Unless suitable poles can be secured in the vicinity it scarcely pays to try to build this outfit, as the materials can seldom be bought from a lumber yard.

A slide stacker, somewhat similar to the overshot stackers shown in Figures 2 and 3 is now manufactured and is in use in scattered sections of the Middle West. Instead of being open, the frame has a slide of light boards and is as wide as the stacker head. Only one set of teeth is necessary as the slide takes the place of the set appearing in Figure 2.

The slide stacker can be used to build individual benches (stacks) if mixed hay is put up; or a group of five to seven benches joined together at the ends making one continuous stack if wild hay is stacked. Individual benches of mixed hay built with a fan-shaped slide are about 16 feet wide, 30 feet long, and 22 feet high, which is 4 feet higher than the stacker. Grouped benches of wild hay usually contain from 10 to 12 tons each.

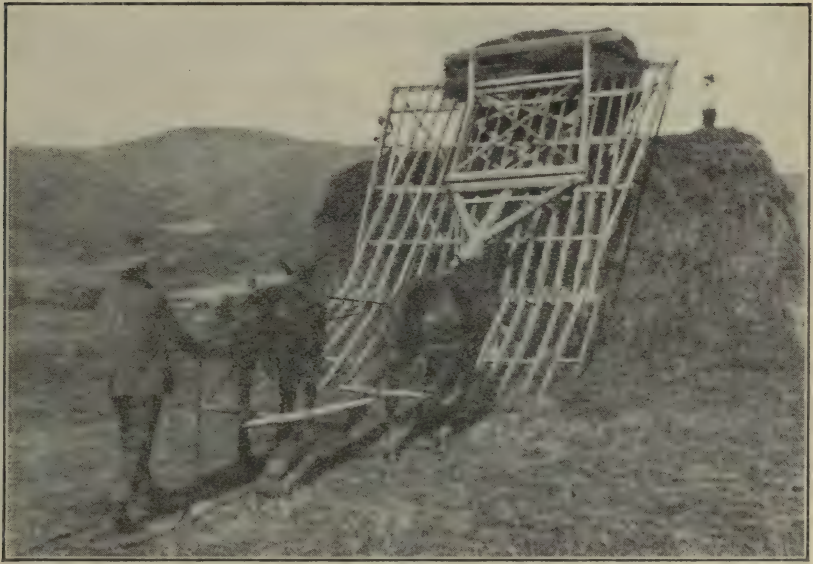

FIGURE 13.—The plunger pushing a load of hay over the top of the slide

Slide stackers are used for putting up both wild and mixed hay in limited localities of the West, but could be used equally well in certain other localities. The usual crew for operating this type of stacker, when putting up wild hay, consists of 3 men operating sweep rakes, 1 man driving the plunger team, 2 men on the stack, 2 men to rake the scatterings. This crew will put up from 5 to 7 stacks, each of 10 to 12 tons, daily.

With mixed hay, a crew of 6 men will put up 60 tons daily. The 2 men needed to rake the scatterings of wild hay are eliminated when mixed hay is being stacked as little if any of this hay is left by the sweep rakes. If only 2 sweep rakes are used, the crew puts up about 40 tons of hay in 9 hours.

The greater capacity of each sweep when a slide stacker is used is caused by the fact that the hay can be left at the foot of the slide as the plunger is able to pick up the hay and push it up on the stack. With all other types of stackers it is usually necessary to give the hay a push after the sweep has placed the hay on the stacker head and has backed away. This takes added time and tends to slow up the daily capacity of each sweep.

CABLE STACKERS

The cable type of stacker is one of the simplest and most generally used of the homemade haying appliances. (Fig. 14.) The A-shaped frames are usually made from poles that can be obtained on the farm or in the neighborhood. The remainder of the material can be bought ready for use from most hardware dealers. Ordinarily the material that must be bought for this outfit consists of 1 reversible cable carrier; 1 double harpoon fork, or grapple fork, or the required number of slings; 150 feet of half-inch galvanized steel cable, on which the carrier travels and which is used also for end guys; 2 cable clamps; 2 long bolts to bolt the tops of the poles together; 3 steel-yoke knot-passing pulleys; 130 feet of ¾-inch manila carrier rope; and 65 feet of trip rope. The height of the stack that can be built with this outfit depends upon the length of the poles used. Poles 32 feet long will serve for most conditions, although poles 60 feet long are used in the far West.

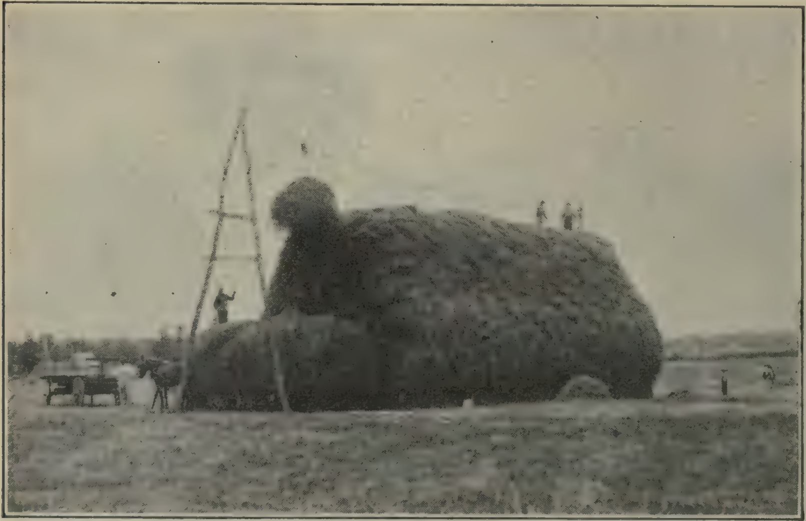

FIGURE 14.—The cable stacker, an inexpensive device using a sling or fork to unload the wagon at the end of the stack. After the hay is elevated the load is tripped at any point on the stack indicated by the stackers. Stacks of alfalfa hay up to 200 tons are made with this outfit

This is a satisfactory type of stacker if hay is stacked each year in a yard adjoining the feed lots. Many farmers use it when unusually large stacks are built in a permanent location, whether near the feed lots or in the fields. It is not so desirable for large stacks of alfalfa hay that is to be sold, as it may be necessary to mix the different cuttings, a practice which usually lowers the value.

To move and set up a cable stacking outfit requires considerable time, and ordinarily fairly large stacks should be made in order to prevent loss of time by the crew while waiting for the stacker to be moved. On many western hay ranches the cable stacker is moved but once during the season.

The ordinary cable stacker is capable of making ricks up to 40 feet in length, and longer ricks can be made when an extra-long cable is used. The width of the rick varies from 12 to 20 feet, and the height varies from 20 to 30 feet. The contents of the stacks may be anywhere from 10 to 30 tons or more. When the quantity of hay stacked per hour or per day is known, the size of the stack may be regulated so that it will be finished about noontime or by evening. If this is done, the crew will lose little time, since the stacker can be taken down and moved in the morning while the crew is waiting for the dew to dry, or at noon, or even late in the evening after the day's work is done.

With larger outfits, such as are used in the West, stacks up to 200 tons are made with the cable stacker. Stacks of this size are usually built near the feed yard, and in dry climate may be kept for two or three years with but little loss.

The rate of stacking with a cable stacker is about the same as when hay is put into a shed or barn with a hay carrier and sling or fork. The difference is that only one man is needed to handle the hay in a shed or barn, whereas two are required on the stack. A crew of 3 men on sweeps, 2 on the stack, 1 trip man, and a stacker-team driver will put up 35 to 40 tons daily. The sweeps drop the hay on slings which take up the entire load of 700 to 1,000 pounds at one time. When wagons are used, the hay is loaded with a hay loader and 2 more men are required but the daily tonnage handled is no greater.

DERRICK STACKERS

Derrick stackers are used to a considerable extent in the Western States, and are especially adapted to alfalfa if the hay is cured in the cock. They are seldom used in sections where mixed and wild hays are stacked as other types are usually more efficient for these kinds of hay.

These stackers are all homemade outfits, therefore considerable variation occurs and many styles are found. According to men who have used different stackers, the derrick excels all others for handling alfalfa hay if it is hauled to the stacker on slips. With this method there is a minimum loss of leaves from shattering and a saving of labor on the stack.

Perhaps the best of these stackers and the one in most general use is the Mormon derrick, two variations of which are shown in Figures 15 and 16.

The Wilson derrick (fig. 17), another style, is a lighter outfit than the Mormon. This stacker requires three supporting cables attached to the top of the pole and to stakes driven in the ground, therefore more men and time are required to move to a new set. Two variations of the Wilson derrick are shown in Figures 18 and 19, and a

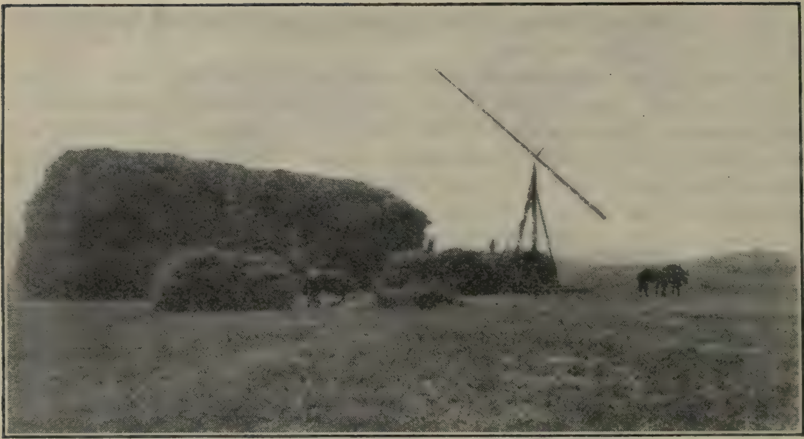

FIGURE 15.—The Mormon derrick stacker, widely used in the intermountain States. Large stacks can be built with this outfit, which is easily moved, as no guy wires are needed for support. Slips are used almost entirely for transporting hay to this type of stacker, although wagons can be used

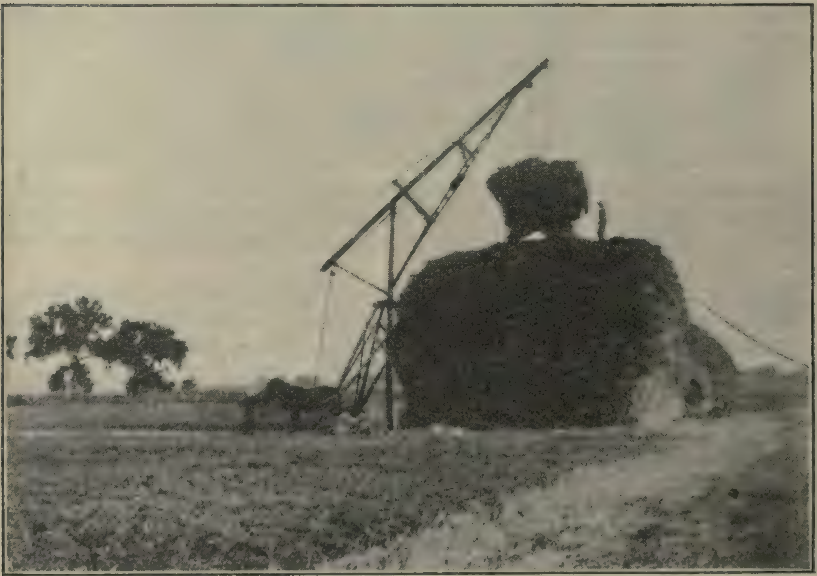

FIGURE 16.—Another style of Mormon derrick with a different bracing; the boom pole and upright turn together

derrick stacker mounted on wheels, which allow it to be moved quickly, is shown in Figure 20. A pole stacker somewhat similar to the Wilson derrick is shown in Figure 21.

Wagons for long hauls and slips for short hauls are used almost exclusively when hay is stacked with a derrick or pole stacker. A hay slip (fig. 22) is a contrivance for transporting hay from the field to the stack. Slips are used almost exclusively with derrick stackers for putting up alfalfa, as they do away with excessive leaf shattering and prevent dust and dirt from mixing with the hay, thus improving its feeding and sale value.

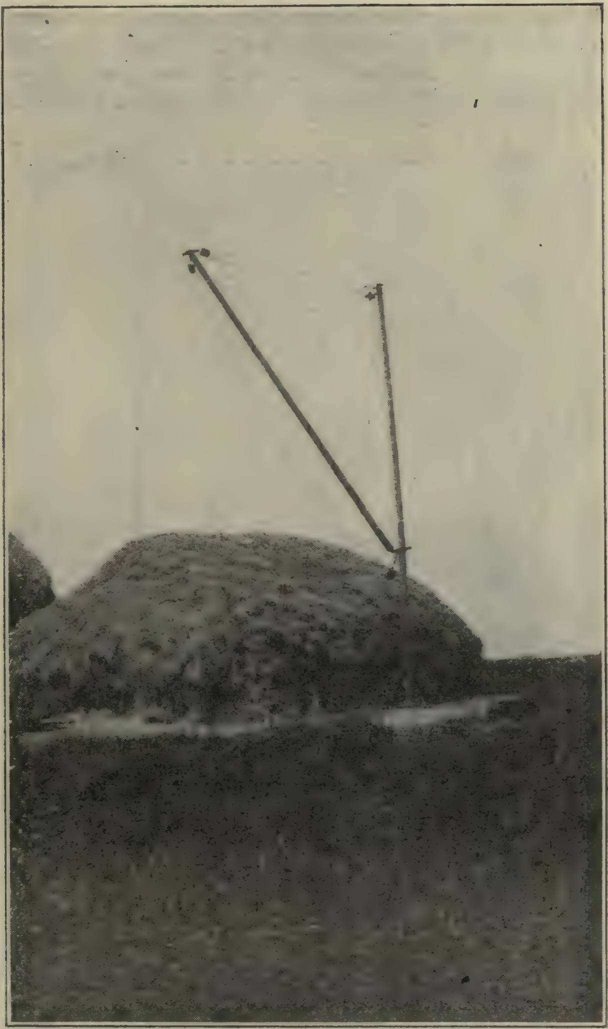

FIGURE 17.—The Wilson derrick. As wire cables are necessary to support this stacker, it is more difficult to move. Both ends of the boom pole are movable

Slips are made in two styles, each having a platform 8 feet wide by 16 feet long. In the simplest form the platform is constructed of 1-inch boards held together on top by four 2 by 4 inch cross pieces. A better form is built on runners and lasts longer than does the former as the runners can be replaced.

In operating a slip, a sling is placed on the bed, or two chains on the bed, one on each side. The hay is then pitched on the slip, which has a capacity of 1,000 pounds or more. When the slip, which is pulled by two horses, reaches the stack, the chains or slings are hooked to the pulley on the stacker and the entire load is elevated at one time.

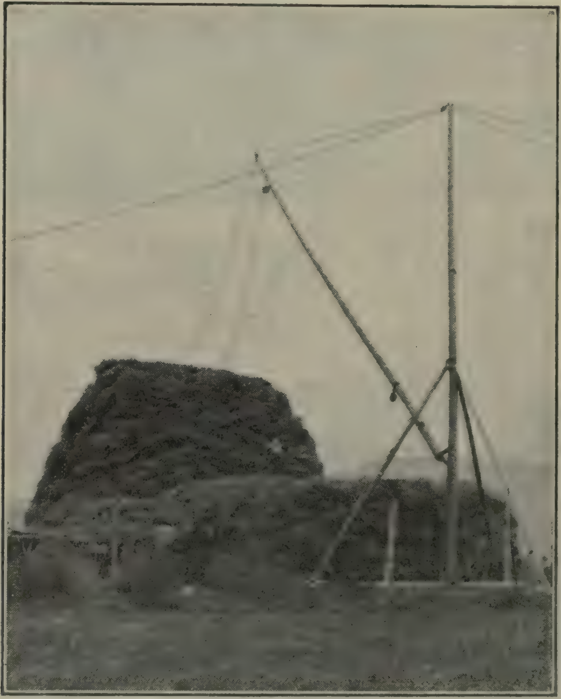

FIGURE 18.—The boom pole on this style of Wilson derrick is fixed to the upright, thus giving but one adjustment

It is possible to use a sweep rake with a derrick stacker, but if this method is employed to deliver the hay, the slings used to elevate the load must be sunk flush with the surface of the ground. The sweep can then be driven onto the slings, and can deposit its load and back away without disturbing them.

If the poles are cut on the farm, the derrick stacker need cost but a few dollars.

The size of stacks made by the different styles of derrick stackers varies considerably. Small stackers of this type are often too low to permit the building of tall stacks. Stacks built with these outfits may contain from 10 to 30 tons. Some of the larger stackers used in the West, like the Mormon derrick, build stacks of 80 to 100 tons, and as high as the cable stackers build. Stacks made by derrick stackers are, in general, not as long as are those made by the cable stacker, because of the large amount of labor required in moving the hay to the ends of the stack. Long stacks sometimes are made by making a bench of moderate length, say 30 feet, and then moving the stacker so that the next bench can be joined to the first one.

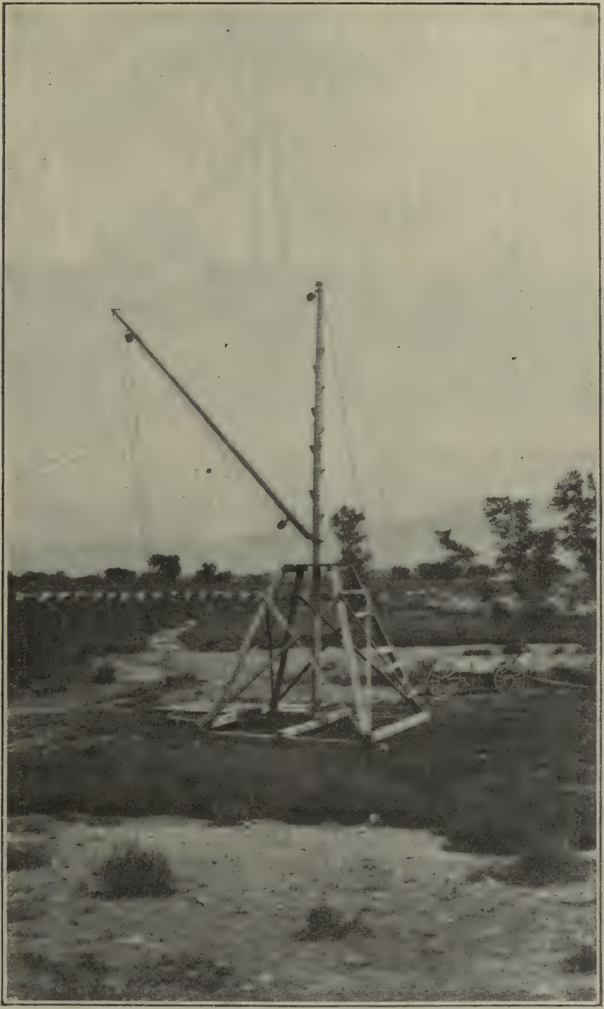

FIGURE 19.—Another style of Wilson derrick. The framework at the bottom allows it to be moved more easily than the unsupported style

Derrick stackers of the Mormon style are almost exclusively used in some western districts in which both large and small acreages of alfalfa hay are grown. They can also be used satisfactorily for other varieties of hay. For putting up a large tonnage of alfalfa hay a crew of seven men with slips is used to haul the hay to the stacker.

Three spike pitchers are in the field to help the drivers load their slips. Each slip makes a round trip every 15 minutes, including about 1½ minutes for unloading at the stack. When the slip comes to the stack the driver and trip man fasten the pulley hook to the two chains on the bed of the slip and the entire load of 1,000 to 1,500 pounds is pulled up on the stack. The derrick team driver and

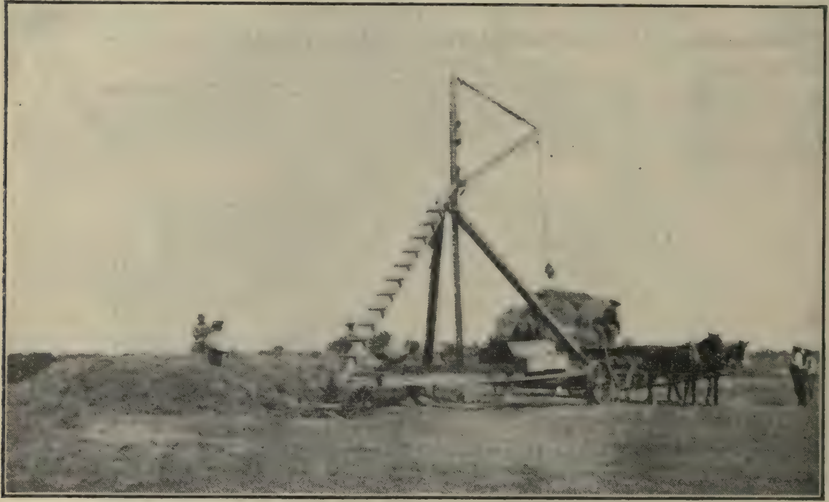

FIGURE 20.—A large, heavily constructed, homemade derrick stacker mounted on wheels. This stacker can handle very large loads of hay and can be moved quickly to a new stack site

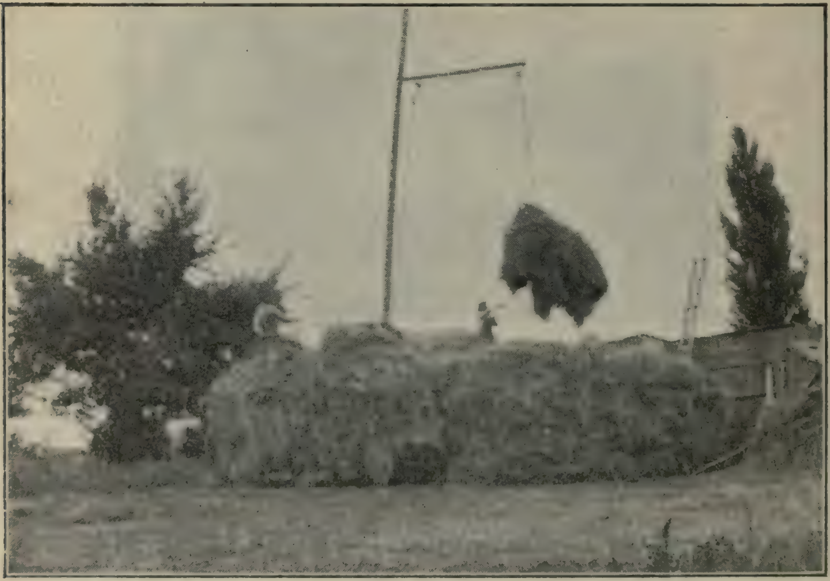

FIGURE 21.—A simple homemade pole stacker, capable of making a very tall stack. As the hay leaves the wagon the stacker turns and the hay is swung over the stack and dropped at the desired point. Stackers of this type must be held by heavy wire guys

two men on the stack complete the crew. This crew stacks from 80 to 90 tons of hay daily, depending on wind and weather.

On smaller acreages with a stacker like the one in Figure 16 a crew of 3 men with slips, 1 spike pitcher to help load, 2 men on the stack, and a man or boy to drive the stacker team will put up about 30 tons daily.

That it is possible to stack as much hay with a smaller crew is illustrated by the performance of a 5-man stacking crew. A spike pitcher is not used, as each man loads his own slip and, by lowering the hay to the top of the stack at a place where it is wanted before it is tripped, one man can do all the stacking.

TRIPOD STACKERS

The tripod stacker is the simplest and perhaps the most easily constructed of all homemade stackers. Three poles about 30 feet long are bolted together at the top. (Fig. 23.) The bottom is spread out far enough to permit a stack of the desired size to be built under the tripod. The equipment consists of three pulleys, a hay rope, a trip rope, and a horse fork. It is not necessary to use guy wires to hold this style of stacker in place, as with some of the derrick and pole stackers.

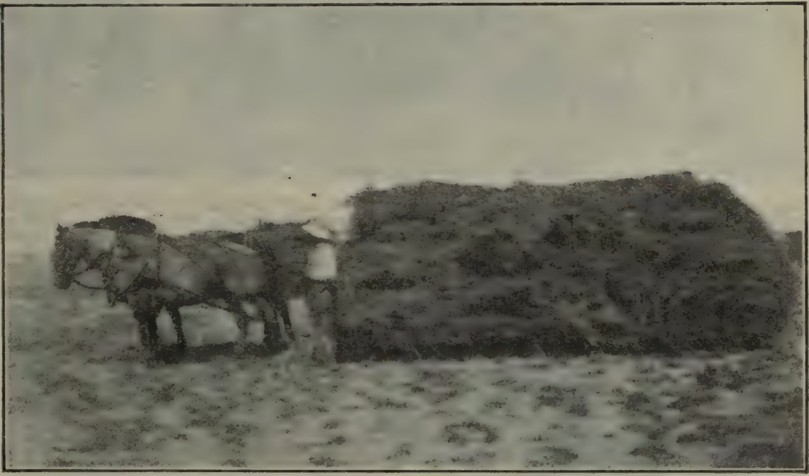

FIGURE 22.—One-half ton of alfalfa hay loaded on a slip that is built on runners

If poles can be obtained for the cutting, the tripod stacker can be built at practically no cost as the fork and rope from the barn can be used in making up the outfit.

The tripod stacker is not adapted to making long or high stacks, and often is used by small crews. This stacker, as well as the cable type, is generally used for stacking hay that is hauled to the stack on wagons. Tripod stackers are easier to move than the cable or derrick stackers, which require the use of guy wires, and for this reason they are generally used for building comparatively small stacks.

This style of stacker is satisfactory for a small crew made of 3 men, or 2 men and a boy. In loading a man or boy drives the team and 2 men handle the hay on the wagon as it is delivered from the hay loader. When the load reaches the stack, one of the crew drives the team which elevates the hay to the stack, one handles the fork or slings on the wagon, and the third member of the crew stacks the hay. With this size crew about 15 to 18 tons of hay are stacked daily.

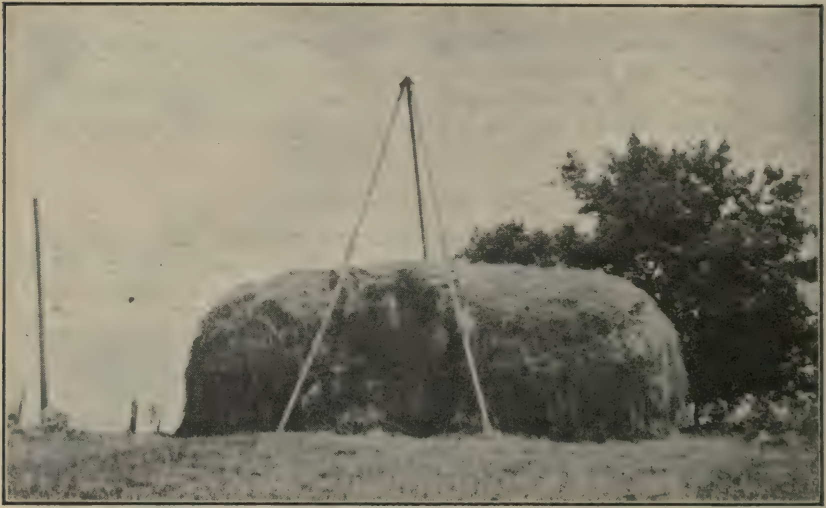

FIGURE 23.—A tripod stacker that can easily be made on the farm. It is self-supporting and can be taken down and moved easily but not so quickly as those mounted on wheels. Stacks larger than this are seldom built by the small crew using a tripod stacker

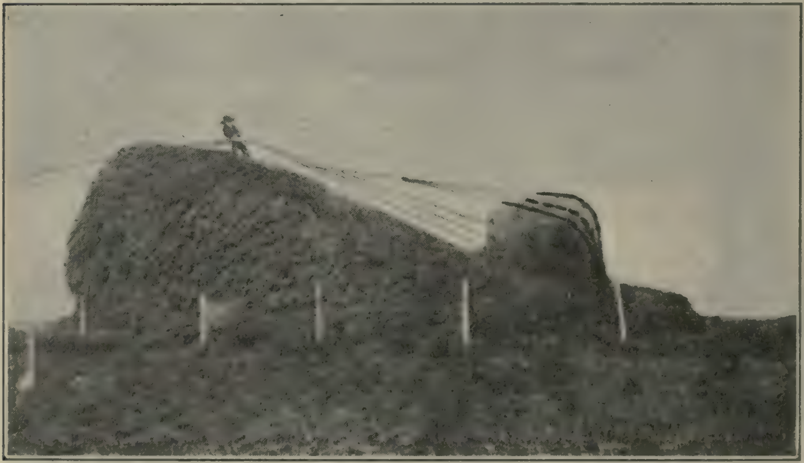

FIGURE 24.—A rope stacker in operation, showing the method of elevating the hay on the stack

By increasing the crew to six men and adding a second wagon, from 30 to 35 tons can be handled daily.

ROPE STACKERS

Cheapness and lightness are the advantages of rope stackers, the principle of which is illustrated in Figure 24. This type is used in a few scattered localities for stacking alfalfa or mixed hay. Compared with other stacking methods, this is a poor one to use.

The style illustrated employs four ropes, three of which are passed lengthwise over the top of the stack and fastened to an iron ring. A stake, over which the ring is placed, is driven into the ground at one end of the stack and far enough away to allow the load to be driven between. The sweep rake deposits its load on the ropes, after which the fourth rope, also on top of the stack, is hooked to the ring which is lifted from the stake. A team hitched to the end of the fourth rope is started, and the hay rolls up the stack. A man on the stack holds the three ropes as the hay rolls up. When the load reaches the desired spot the ropes are dropped and removed, the hay is stacked, and the ropes are rearranged for the next load.

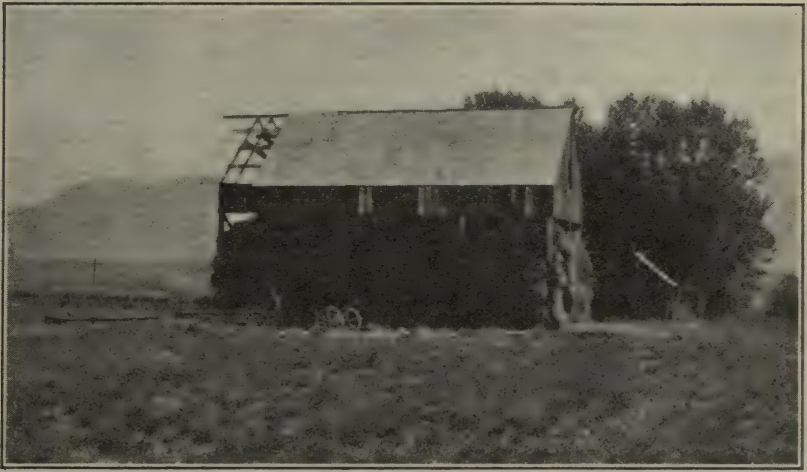

FIGURE 25.—A hay shed, showing the method of protecting stacked hay in districts of heavy rain or snowfall

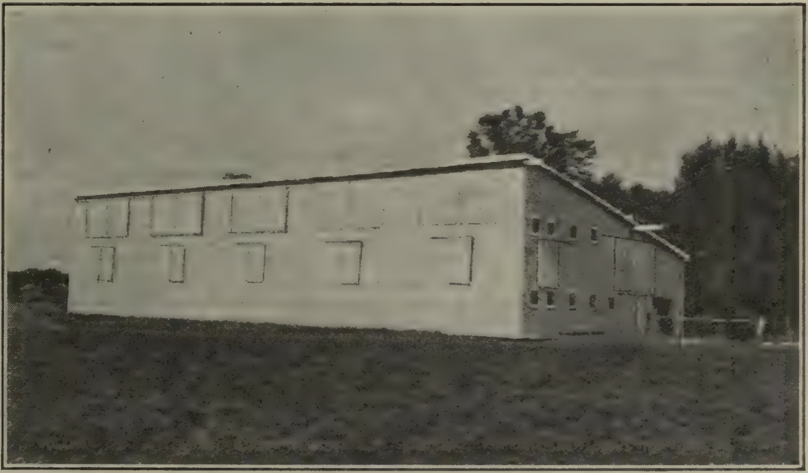

FIGURE 26.—A hay barn constructed so that the hay may be put into the barn through doors by means of an overshot stacker

Another style is also used which employs two ropes, which are attached to a ring on one end and on the other end to stakes or poles driven in the ground at the far end of the stack. When the load reaches the desired place on the stack, the team is stopped and the ropes are pulled out and thrown to the sides of the stack.

This type of stacker builds a stack which is suitable only for districts of light rainfall, as the stack is rather rough and does not shed water readily. The stack is also of peculiar shape, in that the end where the hay is elevated is lower than the opposite end and can not be built up to an equal height when the stack is completed.

The tonnage of hay stacked daily by the crew with this outfit is lower than that for the same size of crew with most of the other styles of stackers described.

HAY SHEDS AND BARNS

In districts in which rainfall is heavy or snow is deep sheds or barns are often used in which to store hay. (Figs. 25 and 26.)

Wagons are most frequently used for hauling from the field when hay is put in a shed or barn. A track and a hay carrier are usually installed and slings or a fork are used for unloading the hay from the wagons, but it is possible to use some types of stackers and stacking equipment for the work. In some districts instead of installing a permanent track and carrier a cable stacker (fig. 14) is used. Two poles, the same as with a cable stacker, are set up outside at one end of the shed or barn and the cable is run through to the other end where it is fastened solidly to the building or to a tree or post on the outside.

If a hay barn similar to that in Figure 26 is constructed, sweep rakes are used to bring the hay in from the field and an overshot stacker is used to put the hay directly into the barn.

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GAME LAWS FOR THE SEASON 1929–30

A SUMMARY OF FEDERAL, STATE, AND PROVINCIAL STATUTES

By Frank L. Earnshaw and Frank G. Grimes, *Administrative Assistants Division of Game and Bird Conservation, Bureau of Biological Survey*

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FEDERAL PROTECTION OF GAME

GAME ADMINISTRATION involves more than the mere exercise of police powers for the protection of wild life. Too frequently game laws are considered to have protection as their sole end, the result being that in some States they are so inelastic as to prevent modification to meet changing conditions. Fortunately, a number of States, recognizing the need for more elastic laws, have empowered game officials to develop and execute conservation programs that may be modified as changing conditions warrant.

Among the functions of the United States Department of Agriculture are the conservation of game and the protection of migratory birds. Its jurisdiction was extended to game in 1900 by the passage of the Lacey Act, which supplements State legislation by regulating interstate commerce in wild animals and governs the importation of foreign wild animals and birds. Of most far-reaching importance, however, are the laws that were passed in 1918, authorizing regulations to give effect to the treaty of 1916 between the United States and Great Britain for the protection of North American migratory birds. In the United States and Canada these laws are known, respectively, as the migratory-bird treaty act and the migratory-birds convention act.

The first Federal migratory-bird law of this country was enacted in 1913, and its enforcement was placed in this department, as was also the administration of the subsequent treaty legislation. The act of 1918 has been most effective in coordinating State laws relating to migratory game birds, and is generally observed, and in most places respected. This legislation conferred power on the department to regulate the taking, possession, and disposition of migratory birds. The fundamental principles that underlie the regulations adopted for its enforcement include the abolition of spring shooting, the prohibition of the sale of migratory game birds, and the prescribing of definite, reasonable daily bag limits. Under the terms of the treaty, open seasons in any State are restricted to a period not exceeding three and one-half months in any one year.

Protection by restriction on hunting, however, is only one of several possible means of accomplishing the objects of the international agreement. Its intention can be defeated in spite of such laws if the birds are denied the use of the breeding and resting grounds that they have enjoyed for countless generations. Increased numbers of migratory waterfowl tax the feeding and carrying capacity of their ever-diminishing range and create urgent problems concerned with their maintenance. The present outstanding need of our birds is a series of refuges in their accustomed habitat along the flight lanes of their annual migrations. Sportsmen and conservationists generally, realizing the necessity for a sustained program in connection with the development and maintenance of wild-fowl breeding and feeding areas throughout the country, have been endeavoring to bring about a system of migratory-bird refuges. Such a system was authorized by the migratory-bird conservation act of February 18, 1929, which provides for the appropriation of $7,800,000 over a period of 10 years for the acquisition of Federal refuge sites. The spread of civilization and consequent commercial developments have made serious inroads into the breeding and feeding grounds of all wild life, especially in the comparatively limited areas suitable for migratory wild fowl. Unwise drainage of many marshes and lakes throughout the country also has destroyed large water areas chiefly suitable for the production of wild life, without compensating benefits.

The Bureau of Biological Survey administers 83 game and bird reservations created specifically for the conservation of wild life. All but 1 are bird refuges, and 5 are big-game preserves. One of the most important of these is the Upper Mississippi River Wild Life and Fish Refuge, administered jointly by the Departments of Agriculture and Commerce. This, and the bird refuges at Big Lake, Ark., Malheur and Upper Klamath Lakes, Oreg., and Tule Lake, Calif., are among the few refuges now under Federal control that are important as breeding, feeding, and resting grounds for migratory game birds. Another important refuge for migratory birds was authorized by Congress on April 23, 1928, at Bear River Bay, Great Salt Lake, Utah. Contracts have been let this year for construction work and improvements necessary at this point to correct conditions that have proved so destructive to waterfowl through alkali poisoning during the past decade.

REVIEW OF LEGISLATION OF 1929

In all the States except Alabama, Kentucky, Louisiana, Mississippi, and Virginia legislative sessions have been held since the last bulletin on the game laws was issued (Farmers' Bulletin No. 1575). More or less extensive revisions in State game laws were enacted in Arizona, Connecticut, Florida, Illinois, Maine, Michigan, Nebraska, Nevada, North Carolina, Pennsylvania, West Virginia, Wisconsin, and Wyoming.

FEDERAL LEGISLATION

AMENDED MIGRATORY-BIRD TREATY-ACT REGULATIONS

Amendments to the migratory-bird treaty-act regulations were approved by the President on April 23, 1929. Seasons were changed on waterfowl, coots, and Wilson's snipe in Illinois and Missouri, where the new season established is September 24 to January 7; in Oklahoma, October 16 to January 31, to harmonize with that established heretofore for the northern part of Texas; and in the State of Washington, east of the summit of the Cascade Mountains, September 16 to December 31.

The season on woodcock was changed in New York to the period October 1 to 31, the same as that provided for Maine, New Hampshire, and Vermont. Mourning-dove seasons were changed in Georgia, North Carolina, and two counties in Alabama. Georgia was placed in the group of Southern States having a split season on mourning doves—during the month of September and from November 20 to January 31. In North Carolina the dove season was made to conform with that on quail, rabbits, and wild turkeys from November 20 to January 31, and in Mobile and Baldwin Counties, Ala., a special season on doves was prescribed from November 1 to January 31.

By failure of the regulations to prescribe definite open seasons on greater and lesser yellowlegs, the 2-year close term, which expired August 16, 1929, was continued for an indefinite period. Under existing regulations it is unlawful to hunt shore birds, except woodcock and Wilson's snipe in the States where open season on these species are provided.

Other amendments to the Federal regulations prohibited hunting of migratory game birds from automobiles, restricted the taking of migratory game birds under scientific collecting permits on any day to the period from half an hour before sunrise to sunset, and required taxidermists engaged in receiving and mounting migratory birds to keep accurate records of all transactions affecting such birds. The regulations were further liberalized in the matter of indorsements of applications for scientific permits.

Amendments to the Alaska game regulations, which became effective on July 1, 1929, were adopted by the Secretary of Agriculture after consultation with the Alaska Game Commission and approval by the Biological Survey of the commission's recommendations. In order to accommodate residents in the far northern areas of Alaska and enable them to supply themselves with meat, the restriction on hunting caribou was liberalized so that these animals may now be taken north of the Arctic Circle at any time of year, and south of the circle from August 20 to December 31, instead of from September 1 to December 31, as formerly. On the Alaska Peninsula the seasonal limit on caribou was reduced to two for a resident and one for a nonresident hunter. Residents of the Kodiak-Afognak group of islands are now permitted to kill large brown and grizzly bears at any time of year when considered a menace to persons, livestock, or property.

An area of 22,000 acres east and north of Cordova in the Eyak Lake and Power Creek region was closed to all hunting and trapping in accordance with local sentiment, as more than 300 residents of the region petitioned for the establishment of the refuge.

FEDERAL REFUGES

Refuges created by Executive order.—Four wild-life refuges have been established by Executive orders since the last bulletin on the game laws was issued. Tule Lake Bird Refuge in northeastern Siskiyou County, Calif., created by Executive order of October 4, 1928, comprises 10,300 acres of Government lands within the Klamath irrigation project. These lands are flooded to a considerable extent by waste water and form an excellent waterfowl resort and an extremely valuable resting and feeding ground for the birds that frequent the area. An area of 2,800 acres in the southern portion of the refuge, which has long been used as a recreational area by local sportsmen, was opened by order of the Secretary to shooting during the waterfowl season. The remaining 7,500 acres of the refuge were reserved strictly for sanctuary purposes.

By Executive order of April 15, 1929, Nunivak Island, in Bering Sea, off the west coast of Alaska, was reserved in connection with the work of the Biological Survey in conducting experiments in the crossing and propagation of reindeer and caribou and as a preserve and breeding grounds for native birds and wild game and fur-bearing animals.

The Fort Keogh Bird Refuge was established on the former military reservation near Miles City, Mont., by Executive order of May 18, 1929. It has a total area of 57,000 acres, including a 70-acre artificial lake. The water area is frequented by waterfowl and other migratory birds and the balance of the refuge is inhabited chiefly by sharp-tailed grouse and ring-necked pheasants. Since 1924 this reservation has been under the control of the Bureau of Animal Industry as a range livestock experiment station for the study of stock grazing and the growing of range forage crops. The establishment of the refuge will not interfere with these experiments nor with the use of the artificial lake by the Montana Fish and Game Commission in the production of warm-water fishes, particularly black bass, in cooperation with the United States Bureau of Fisheries.

The Cedar Keys Bird Refuge, off the west coast of Levy County, Fla., established by order of July 16, 1929, comprises the small islands known as Snake Key, Dead Man or Bird Key, and North Key, which are important nesting and wintering grounds for large numbers of aquatic birds, including several species of herons, pelicans, and cormorants, some of which are becoming greatly depleted in numbers.

Migratory-bird refuges.—The approval on February 18, 1929, of the migratory-bird conservation act, marked the culmination of eight years of effort by sportsmen and conservationists throughout the country for establishing a Federal system of migratory-bird refuges along the flight lanes and in the concentration areas of waterfowl and other migratory birds. As finally enacted the law authorizes the creation of inviolate sanctuaries under direct appropriation by Congress over a period of 10 years. The passage of this act was followed by an appropriation of $75,000 to cover the first year's expenses of investigating proposed refuge sites and the formulation of a more definite Federal program for national refuges. The total appropriation authorized during the 10-year period is $7,875,000. The act also affords additional protection to existing reservations and those hereafter established by Executive orders or by special acts of Congress.

The Migratory-Bird Conservation Commission created by the act is composed of the Secretary of Agriculture (chairman), the Secretary of Commerce, the Secretary of the Interior, two Members of the Senate, and two Members of the House of Representatives. The chief game official of the State, or a representative designated by the governor in States having no game department, is also made a member of the commission for the purpose of considering and passing upon areas in his own State. The commission is required to pass upon the advisability of obtaining areas recommended by the Secretary of Agriculture for purchase or lease under the provisions of the law for refuge purposes and to fix the price or prices at which such areas may be purchased or rented.

The act specifically provides that no area in any State may be acquired by the Federal Government for refuge purposes until that State has consented by law to the acquisition of lands by the United States for public purposes within its borders. Notwithstanding the fact that most of the legislatures in the States holding sessions this year were well under way at the time of the enactment of this Federal legislation, no less than nine States—Kansas, Montana, South Dakota, North Carolina, New York, Missouri, California, Florida, and Illinois—enacted special legislation in 1929 consenting to Federal acquisition of areas within their borders for migratory-bird refuge purposes. A careful study of existing State legislation on the subject reveals that 17 States already have granted to the Federal Government sufficient authority to proceed with the acquisition of lands for refuge areas. These States are Arizona, Colorado, Connecticut, Georgia, Iowa, Louisiana, Maine, Maryland, Michigan, Minnesota, Nevada, New Mexico, Ohio, Oklahoma, South Carolina, West Virginia, and Wyoming.

CANADIAN REGULATIONS

The amendments to the Canadian regulations on migratory birds, approved by order in council in July, 1929, continued until 1932 the close season on yellowlegs, plovers, curlews, and all shore birds except woodcock and Wilson's snipe. The daily bag limit on woodcock was reduced from 10 to 8, and a seasonal limit of 125 birds was prescribed for all the Provinces in which woodcock hunting is allowed—New Brunswick, Nova Scotia, Ontario, Prince Edward Island, and Quebec. The open season on woodcock for the Grand Manan Islands group and that on Wilson's snipe south of the French and Mattawa Rivers in Ontario were shortened half a month.

In Nova Scotia the general season on waterfowl, rails, coots, and gallinules, except in Cumberland County, was changed to the period October 1 to January 15 from the former season September 15 to December 31. The season on geese and brant was shortened one month in Shelburne, Halifax, and Queens Counties by opening on December 1 instead of November 1.

The use of live decoys was prohibited in hunting band-tailed pigeons in British Columbia.

STATE AND PROVINCIAL LEGISLATION

MIGRATORY GAME BIRDS

State laws were brought into further harmony with the Federal regulations on migratory birds through the adoption of special legislation in Connecticut, New York, and West Virginia. In Connecticut and West Virginia the future amendments to the Federal regulations will automatically become the law of these States, while in New York the conservation department is authorized to adopt regulations making State seasons and bag limits conform with the Federal provisions as they are amended from time to time.

Waterfowl and shore birds.—In West Virginia a definite provision was enacted reducing the daily bag limit on ducks from 25 to 15 and that on geese from 8 to 4. The limit on ducks was also reduced in Arizona from 20 to 15 a day and that on geese and brant from 8 to 2. Iowa reduced the number of waterfowl allowed in possession at one time from 50 to 21. Maine prescribed a limit of 2 a day on Wilson's snipe instead of 10 as formerly. Michigan eliminated the weekly bag limit of 50 on wild ducks but prescribed a season limit of 100, reduced the season limit on geese and brant from 15 to 10, and the possession limit on woodcock from 10 to 8 and the season limit from 20 to 16; the woodcock season was slightly lengthened by opening October 15 instead of October 25. The limits on rails and coots also were reduced in Michigan. In Pennsylvania the board of game commissioners adopted regulations revising the hunting seasons in that State; the season on waterfowl and coots was lengthened two weeks by opening October 1 instead of October 15. Vermont reduced the daily limit on ducks from 20 to 12 and prescribed a season limit of 50. The limit on geese in Vermont was reduced from 8 a day to 5 a season.

Mourning doves.—Arizona reduced the limit on mourning doves from 25 to 20 a day. Nebraska prescribed the first 15 days in September as an open season on doves and established a daily bag and possession limit of 15, the number of game birds of all kinds allowed in possession at one time being reduced from 50 to 40. Texas changed the dove season in the southern zone and adopted a number of local seasons affecting counties in the eastern section of the State in both the north and south zones. Owing to the conflict between the seasons prescribed under this new legislation and those provided by the Federal regulations, the legal season during which mourning doves may be hunted in the areas affected without violating either State or Federal law, hunters will find their dove-shooting privileges somewhat more curtailed than in previous seasons. The details of these changes are too numerous to include here, but may be found in the summary of Texas laws later in the bulletin.

UPLAND GAME BIRDS

Ruffed grouse.—Ruffed grouse generally received additional protection under legislation adopted this year, in the form of close seasons, shortened open seasons, or reduced bag limits. Close seasons were continued or adopted in Illinois, Minnesota, Nebraska, Pennsylvania, Vermont, Wisconsin, and Manitoba, and in New Jersey five counties were closed to the hunting of these birds. Daily and seasonal bag limits were reduced in Connecticut from 3 to 2 a day and 21 to 15 a season.

West Virginia reduced the daily limit from 4 to 3 and the season limit from 20 to 15. In Maine the former 2-month open season on ruffed grouse was reduced and hunting limited to the month of October, and the limit was shortened from 5 to 4 a day.

Other grouse.—The season on mountain and willow grouse, prairie chickens, and sage hens was closed for four years in Colorado and that on prairie chickens, or pinnated grouse, for two years in Nebraska. Wisconsin abolished the open season in alternate years on prairie chickens, sharp-tailed grouse, and spruce hens. In Texas the open season on prairie chickens was shortened from the first 10 days to the first 4 days of September. Manitoba continued the close season on prairie chickens, or pinnated grouse.

Other upland game birds.—The close season on wild turkeys was continued in Illinois for two years. Missouri reduced the limit on turkeys from 4 to 1 a season. North Carolina shortened the open season a few days on quail and wild turkeys by fixing the hunting season from November 20 to February 15, instead of the former period from December 1 to March 1. Pennsylvania, by regulation of the board of game commissioners, restricted the upland-game-bird season to the month of November, except on wild turkeys and male ring-necked pheasants, which may now be hunted only during the first half of that month.

BIG GAME

The tendency in this year's legislation was to restrict further the taking of big-game animals. Changes affecting one species or another were made in Florida, Maine, New York, North Carolina, South Dakota, West Virginia, Wyoming, British Columbia, Northwest Territories, Nova Scotia, Ontario, and Yukon.

STATE GAME REFUGES

Particular attention was given to the establishment of State game refuges in a number of the States. California created 4 new refuges, Colorado 2, Idaho 6, and Utah, Minnesota, and New Brunswick 1 each. Utah also adopted a special bill to facilitate the establishment of the Bear River Migratory Bird Refuge in that State. Minnesota enlarged the powers of its game commission in the matter of the acquisition of lands for refuges and public-shooting grounds. Lands and waters heretofore or hereafter inclosed as private game farms are also made permanent wild-fowl refuges. West Virginia provided that 10 per cent of its hunting-license receipts shall be expended in establishing and maintaining game refuges and public-shooting grounds, and that one-third of any area acquired or controlled by the State shall be used for refuge purposes and the other two-thirds for public-shooting grounds. Authority was also continued for the commission to establish refuges on private lands, on areas of not less than 2,000 acres, for 10-year periods.

FEDERAL LAWS RELATING TO MIGRATORY BIRDS [1]

Migratory birds included in the terms of the convention between the United States and Great Britain for the protection of migratory birds, concluded August 16, 1916, are as follows:

1. *Migratory game birds:*

(*a*) Anatidae, or waterfowl, including brant, wild ducks, geese, and swans.

(*b*) Gruidae, or cranes, including little brown, sand-hill, and whooping cranes.

(*c*) Rallidae, or rails, including coot, gallinules, and sora and other rails.

(*d*) Limicolae, or shore birds, including avocets, curlews, dowitchers, godwits, knots, oyster catchers, phalaropes, plovers, sandpipers, snipe, stilts, surf birds, turnstones, willet, woodcock, and yellowlegs.

(*e*) Columbidae, or pigeons, including doves and wild pigeons.

2. *Migratory insectivorous birds:* Cuckoos; flickers and other woodpeckers; nighthawks or bullbats and whippoorwills; swifts; hummingbirds; flycatchers; bobolinks, meadowlarks, and orioles; grosbeaks; tanagers; martins and other swallows; waxwings; shrikes; vireos; warblers; pipits; catbirds and brown thrashers; wrens; brown creepers; nuthatches; chickadees and titmice; kinglets and gnat catchers; robins and other thrushes; and all other perching birds which feed entirely or chiefly on insects.

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[1] The full text of the migratory-bird treaty act and regulations and of other Federal laws affecting birds and game is contained in Service and Regulatory Announcement—B. S. No. 71, which may be obtained from the Secretary of Agriculture, Washington, D. C. Likewise the Canadian migratory-bird regulations may be obtained from the Commissioner, National Parks of Canada, Ottawa, Ontario.

3. *Other migratory nongame birds:* Auks, auklets, bitterns, fulmars, gannets, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, and terns.

OPEN SEASONS UNDER FEDERAL REGULATIONS

Following are the provisions of the Federal regulations, with amendments of April 23, 1929, fixing open seasons on migratory game birds, which seasons are in some instances further shortened by State regulation (for dates during which a person may hunt these birds without violating either Federal regulations or State law, see the open seasons shown for the various States, beginning on p. 9):

Waterfowl (except wood duck, eider ducks, and swans), coot, and Wilson's snipe or jacksnipe.—The open seasons for waterfowl (except wood duck, eider ducks, and swans), coot, and Wilson's snipe or jacksnipe shall be as follows:

In Maine, New Hampshire, Vermont, Massachusetts (except in Nantucket and Dukes Counties and Barnstable County, south and east of Cape Cod Canal), Ohio, West Virginia, Michigan, Wisconsin, Minnesota, Iowa, North Dakota, South Dakota, Nebraska, Kansas, Colorado, Wyoming, Montana, Nevada, and that portion of Idaho comprising the counties of Boundary, Bonner, Kootenai, Benewah, and Shoshone, and that portion of Washington lying east of the summit of the Cascade Mountains, the open season shall be from September 16 to December 31;

In New York (except Long Island), Illinois, and Missouri the open season shall be from September 24 to January 7;

In that portion of Massachusetts known as Nantucket and Dukes Counties, and Barnstable County, south and east of Cape Cod Canal, and in Rhode Island, Connecticut, Pennsylvania, Indiana, Utah, Idaho (except in the counties of Boundary, Bonner, Kootenai, Benewah, and Shoshone), California, Oregon, and that portion of Washington lying west of the summit of the Cascade Mountains, the open season shall be from October 1 to January 15;

In that portion of New York known as Long Island, and in New Jersey, Delaware, Oklahoma, New Mexico, Arizona, that portion of Texas lying west and north of a line beginning on the Rio Grande River directly west of the town of Del Rio, Tex.; thence east to the town of Del Rio; thence easterly following the center of the main track of the Southern Pacific Railroad through the towns of Spofford, Uvalde, and Hondo; thence to the point where the Southern Pacific Railroad crosses the International & Great Northern Railroad, at or near San Antonio; thence following the center of the track of said International & Great Northern Railroad in an easterly direction, to the point in the City of Austin, where it joins Congress Avenue, near the International & Great Northern Railroad depot; thence across said Congress Avenue to the center of the main track of the Houston & Texas Central Railroad where said track joins said Congress Avenue, at or near the Houston & Texas Central Railroad depot; thence following the center line of the track of said Houston & Texas Central Railroad in an easterly direction through the towns of Elgin, Giddings, and Brenham, to the point where said railroad crosses the Brazos River; thence with the center of said Brazos River in a general northerly direction, to the point on said river where the Beaumont branch of the Sante Fe Railway crosses the same; thence with the center of the track of the said Gulf, Colorado & Santa Fe Railway, in an easterly direction through the towns of Navasota, Montgomery, and Conroe, to the point at or near Cleveland, where said Gulf, Colorado & Santa Fe Railway crosses the Houston, East & West Texas Railroad; thence with the center of said Houston, East & West Texas Railroad track to the point in said line, where it strikes the Louisiana line, the open season shall be from October 16 to January 31, and in that portion of Texas lying south and east of the line above described the open season shall be from November 1 to January 31;

In Maryland, the District of Columbia, Virginia, Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Arkansas, and Louisiana, the open season shall be from November 1 to January 31; and

In Alaska the open season shall be from September 1 to December 15.

Rails and gallinules (except coot).—The open season for sora and other rails and gallinules (except coot) shall be from September 1 to November 30, except as follows:

In Massachusetts the open season shall be from September 16 to December 15; and

In Louisiana the open season shall be from November 1 to January 31.

Woodcock.—The open seasons for woodcock shall be as follows:

In Maine, New Hampshire, Vermont, New York, and North Dakota the open season shall be from October 1 to October 31;

In Massachusetts, Rhode Island, and Connecticut the open season shall be from October 20 to November 19;

In New Jersey, Pennsylvania, Ohio, Indiana, Michigan, Wisconsin, and Iowa the open season shall be from October 15 to November 14;

In Maryland, the District of Columbia, and Missouri the open season shall be from November 10 to December 10;

In Delaware, Virginia, West Virginia, Kentucky, Arkansas, and Oklahoma the open season shall be from November 15 to December 15; and

In North Carolina, South Carolina, Georgia, Alabama, Mississippi, and Louisiana the open season shall be from December 1 to December 31.

Doves.—The open seasons for mourning doves shall be as follows:

In Delaware, Maryland, Virginia, Tennessee, Kentucky, Ohio, Indiana, Illinois, Minnesota, Nebraska, Kansas, Missouri, Arkansas, Oklahoma, New Mexico, Colorado, Utah, Arizona, California, Nevada, Idaho, Oregon, that portion of Texas lying west and north of the zone line described above under "Waterfowl," the open season shall be from September 1 to December 15; and in that portion of Texas lying south and east of the line above described the open season shall be from November 1 to December 31;

In South Carolina, Georgia, Florida, Alabama (except in Mobile and Baldwin Counties), Mississippi, and Louisiana, the open season shall be from September 1 to September 30 and from November 20 to January 31;

In that portion of Alabama known as Mobile and Baldwin Counties, the open season shall be from November 1 to January 31; and in North Carolina the open season shall be from November 20 to January 31.

BAG LIMITS AND OTHER PROVISIONS UNDER FEDERAL REGULATIONS

Bag limits.—A person may take in any one day during the open season prescribed therefor not to exceed the following numbers of migratory game birds, which numbers shall include all birds taken by any person who for hire accompanies or assists him in taking migratory birds:

Ducks (except wood duck and eider ducks), 25 in the aggregate of all kinds.
Geese, 8 in the aggregate of all kinds.
Brant, 8.
Rails and gallinules (except sora and coot), 25 in the aggregate of all kinds, but not more than 15 of any one species.
Coots, 25.
Sora, 25.
Wilson's snipe, 20.
Woodcock, 4.
Mourning doves, 25.

No other migratory birds may be taken at any time except under permit for propagating, scientific, or banding purposes, or under an order of the Secretary of Agriculture to prevent injury to agricultural or other interests.

Time of day and methods.—Migratory game birds may be taken from the land and water on any day during the open season from half an hour before sunrise to sunset with a gun not larger than 10 gauge, fired from the shoulder, with the aid of a dog, the use of decoys, and from a blind or floating device other than an automobile, airplane, power boat, sailboat, any boat under sail, or any floating device towed by powerboat or sailboat, or any sinkbox (battery), except that sinkboxes (batteries) may be used in taking waterfowl in coastal sounds and bays (including Back Bay, Princess Anne County, Va.), and other coastal waters; and the use of an airplane or a power boat, sailboat, or other floating device for the purpose of concentrating, driving, rallying, or stirring up migratory waterfowl is prohibited.

Possession.—Migratory game birds legally taken may be possessed during the period constituting the open season where killed and for an additional period of 10 days next succeeding such open season, and those coming from a country other than Canada may be possessed in the State into which they are brought only during the open season in that State and such additional time immediately thereafter as may be permitted by both Federal and State laws.

Interstate traffic in game.—Not more than two days' bag limit of migratory game birds may be exported or removed from the State where taken in any one calendar week, and such migratory game birds or parts thereof in transit during the open season may continue in transit such additional time, not exceeding five days, as may be necessary for delivery at destination.

The Lacey Act prohibits interstate shipment by common carrier of wild animals or parts thereof where such animals have been killed or shipped in violation of the laws of the State in which killed or from which shipped, and section 4 of the treaty act likewise prohibits the removal in any manner from one State to another of any wild birds in violation of State laws or which have been illegally taken. All packages in interstate commerce containing game animals or nonmigratory game birds, or parts thereof, must be marked to show the names and addresses of the consignor and consignee and the nature of the contents, and packages containing migratory birds must be marked with such addresses and the number and kind of such birds therein.

Sale.—The Federal law prohibits the sale of all migratory birds throughout the United States except birds taken for scientific or propagating purposes and waterfowl raised on farms or preserves under permit from the Secretary of Agriculture.[2] Feathers of wild ducks and wild geese lawfully killed, and of such birds seized and condemned by Federal or State authorities, may be purchased and sold for use in the manufacture or fishing flies, pillows, and mattresses, but not for millinery or ornamental purposes.

Alaskan exceptions.—In Alaska, Eskimos and Indians may take for the use of themselves and their immediate families, in any manner and at any time, and possess and transport auks, auklets, guillemots, murres, and puffins and their eggs for food and their skins for clothing.

Permits for propagation and other purposes.—Under appropriate permit from the Secretary of Agriculture, and when allowed by State law, migratory waterfowl may be captured at any time for propagating purposes, and waterfowl bred in captivity may be killed and the carcasses sold and used for food purposes. Waterfowl captured and bred in captivity may also be sold alive for breeding and exhibition purposes to the holders of permits. Under appropriate permit all species of migratory birds, except whooping cranes, trumpeter swans, and Eskimo curlew, may be taken for scientific purposes, and all species may be taken for banding. The Secretary of Agriculture may also issue orders permitting the killing of migratory birds to prevent serious injury to agriculture or other interests.

Further restrictions by States.—The States may shorten the open seasons fixed by Federal regulations on migratory birds, reduce the bag limits, prohibit export, restrict the period during which migratory birds may be possessed in close season, or make other laws or regulations to give further protection to such birds, but may not lengthen the open season, increase the bag limit, permit sale, or otherwise lessen the protection afforded by Federal law.

SUMMARY OF LAWS RELATING TO SEASONS, LICENSES, LIMITS, POSSESSION, INTERSTATE TRANSPORTATION, AND SALE

Game laws and information.—Persons are advised to obtain from State game commissioners the full text of game laws in States where hunting is contemplated. (See list on p. II, back of title-page.) They should also obtain information from the Bureau of Biological Survey or State game departments[3] regarding the existence of Federal and State game and bird refuges in areas in which they contemplate hunting, as the location of refuges and the restrictions regarding hunting thereon are not included in this bulletin.

Open season dates.—The dates of open seasons for migratory game birds shown under the various States and Provinces are the times when these birds may be hunted without violating either State or Provincial laws or Federal or Canadian regulations.

In stating the open season[4] the plan has been followed of including the first and last days thereof. The difficulty of attaining absolute accuracy in a statement of the seasons is great, but summaries have been submitted to the proper State or provincial game officials for correction and approval, and the dates as stated are believed to be free from material errors.

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[2] See footnote 1, p. 5.

[3] See list on page II (back of title-page). A full list of names and addresses of officials and organizations concerned with the protection of birds and game will be found in Misc. Pub. No. 57, U. S. Dept. Agr., 1929.

[4] For open seasons on fur-bearing animals for the season 1929–30 see Farmers' Bulletin No. 1618.

Permanent close seasons.—Species (including migratory game[5] and nongame[5] birds—but not migratory insectivorous[5] birds—protected throughout each year by Federal regulations) on which the season is closed for a term of years or for an indefinite period are grouped under the term "No open season." Provisions of State laws prohibiting hunting at night, between sunset and sunrise, or during certain hours are not included.

Rest days.—In some States certain days of the week constitute rest days or close seasons during the time when hunting is permitted. Hunting on Sunday is prohibited in all States and Provinces east of the one-hundred and fifth meridian, except Illinois, Louisiana, Michigan, Rhode Island, Texas, Wisconsin, and Quebec. Mondays constitute a close season for waterfowl locally in California and North Carolina; Wednesdays for ducks in Wisconsin; and certain other week days for waterfowl in several favorite ducking grounds in California, Maryland, Virginia, North Carolina, and Florida. In Oregon mountain and valley quail, Hungarian partridges, and Chinese pheasants may be hunted locally only on Wednesday and Sunday of each week during the open season. In Oklahoma quail may be hunted only on Monday, Wednesday, and Friday of each week during the open season, and on Thanksgiving Day and Christmas and New Year's Day, or the preceding Saturdays, if these fall on Sundays. Hunting is prohibited when snow is on the ground in New Jersey, Delaware, and Virginia, and locally on all game except waterfowl in Maryland.

Possession.—The provision of the Federal regulations permitting the possession of migratory game birds during the first 10 days of the close season has been considered in connection with State laws, and when migratory game birds may be possessed during any part of the close season without violating either the Federal regulations or State laws it has been stated under the heading "Bag limits and possession."

Possession of nonmigratory game during the close season is generally prohibited by State laws, but when an extension of a few days, or a special season, is provided for either possession or sale, attention is called thereto.

Interstate transportation.—Under the heading "Interstate transportation," in addition to statements of restrictions on removal of game from the State in which it is taken, information has been included concerning the importation and possession by sportsmen for personal use of game legally killed outside the State and legally exported from the place where taken. In the absence of specific State legislation to the contrary, or where legislation prohibits possession of game in close season, it has been construed that sportsmen may bring home their game and possess it in their State in the same manner as if it had been killed there.

Propagated and imported game.—For laws concerning traffic in imported game and game raised in captivity under Federal and State licenses, see pages 43 to 46.

STATE LAWS

ALABAMA

Open seasons:[6]	*Dates inclusive*
Deer (male)	Nov. 1–Dec. 31.
Bear	Nov. 1–Feb. 28.
Squirrel (black, gray, fox)	Nov. 1–Jan. 31.[7]
Quail (partridge)	Nov. 20–Feb. 20.
Wild turkey gobbler	Dec. 1–Mar. 31.
Turtle dove (see exception)	Sept. 1–Sept. 30. Nov. 20–Jan. 31.
Exception: In Mobile and Baldwin Counties	Nov. 1–Jan. 31.
Duck, goose, brant, Wilson's snipe, coot (mud hen)	Nov. 1–Jan. 31.
Woodcock	Dec. 1–Dec. 31.
Rail and gallinule, other than coot	Sept. 1–Nov. 30.

No open season: Ruffed grouse (pheasant), introduced pheasants, or other introduced game bird (1931); does, turkey hens, swans, wood duck, bitterns, sand-hill and whooping cranes, grebes, gulls, herons, loons, shearwaters, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident or alien, game, $25; fish, $5. Resident: Game, State, $3; county, $1. Trapping (bears and other fur-bearing animals), $15 for first trap and $2.50 for each additional trap. Issued by probate judges. Landlords and members of families may hunt or trap on own land during open season without license. Written permission required for hunting or trapping on land of another.

Bag limits and possession: One buck a day or in possession, 5 a season; 1 turkey gobbler a day or in possession, 10 a season; 10 squirrels a day or in possession; 15 quails a day or in possession; 8 each of geese and brant a day, 25 of each in possession; 20 Wilson's snipe a day, 25 in possession; 25 each of doves, ducks, coots, and sora a day or in possession; 25 in all of rails (except sora) and gallinules a day, but not more than 15 of any one species, 25 each in possession; 4 woodcock a day, 25 in possession. Possession of migratory game birds permitted during first 10 days of close season; other game during first 5 days.

Interstate transportation: Export of all protected game prohibited, except that a nonresident licensee may take with him, openly, game he has lawfully killed, but not more than two days' limit of migratory birds may be exported in any one calendar week.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale of all protected game prohibited.

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[5] For definitions see p. 5.

[6] *Alabama:* Hunting prohibited on all State lands.

[7] Squirrels may be killed at any time on own premises when destroying property.

ALASKA

Open seasons:[8]	*Dates inclusive*
Bull moose,[9] mountain goat	Sept. 1–Dec. 31.
Caribou, south of Arctic Circle	Aug. 20–Dec. 31.
North of Arctic Circle	No close season.
Deer (male, with horns not less than 3 inches above skull) east of longitude 141° only (southeastern Alaska)	Sept. 1–Nov. 30.
Mountain sheep (ram)	Aug. 20–Dec. 31.[9]
Bear (large brown and grizzly)	Sept. 1–June 20.[10]
Black bear (fur animal—including its brown and blue, or glacier bear, color variations), in fur district 1	Oct. 1–May 31.
In fur district 2:	
North, summit Alaska Range and Ahklun Mountains	No close season.
South	Sept. 1–June 20.[10]
Polar bear in fur districts 2 and 3, and black bear in fur district 3	No close season
Grouse, ptarmigan	Sept. 1–Feb. 28.
Duck (except eider duck), goose, brant, Wilson's snipe or jacksnipe	Sept. 1–Dec. 15.

No open season: Buffalo; elk; calf, yearling, and cow moose; fawns and doe deer; lambs and ewes; mountain-goat kids; fawns of caribou; swans, eider ducks, rails, coot, cranes, auklets, fulmars, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, terns, and all shore birds (except Wilson's snipe or jacksnipe).

Hunting licenses: Nonresident citizen: General, $50; small game, $10; nonresident big-game hunter must be accompanied by registered guide except in fur district 3; licenses issued by commissioners, wardens, and special agents. Resident, $2 (trapping license required for taking black bears, which are fur animals under the law; not required of native-born Indians, Eskimos, or half-breeds who have not exercised the right of franchise or severed their tribal relations). Alien, $100 (special license required to hunt or possess firearms); issued by commission. Licensed hunters, within 30 days after expiration of license, must report to commission number and kind of each species of birds or animals taken.

Guide, $10 (issued only to resident citizens or resident native Indian or Eskimo); issued by commission. Guide must report to commission after each hunting trip.

Shipping licenses: Resident (export for mounting and return), $1 for each trophy; resident removing from Territory, $5 for each trophy. Issued by commission or collector of customs.

Bag limits and possession: Caribou, nonresident 2, resident 5, a season (except on Alaska Peninsula, resident 2, nonresident 1); mountain sheep, nonresident 2, resident 3, a season, of which not more than 2 may be taken south of Arctic Circle; 1 moose, 3 deer, 3 mountain goats a season or in possession; 3 in all of large brown and grizzly bears a season or in possession, except on Kenai Peninsula south of Portage Creek and Passage Canal, on the Kodiak-Afognak Islands Group, and on Alaska Peninsula south and west of Kvichak River, Iliamna Lake, and portage from Kamishak Bay to Kakhonak Bay, 2 in the aggregate; black bear in fur district 2, south of Alaska Range and Ahklun Mountains, 2 during September. Game animals legally taken during open season may be possessed and transported within Territory by any person at any time. Number of game animals in excess of season limit may be possessed under permit of commission; 15 grouse, 25 ptarmigan, but not more than 25 in all of grouse and ptarmigan a day; 25 ducks, 8 geese, 8 brant a day, 75 waterfowl in possession; 20 Wilson's snipe a day. Migratory game birds legally taken may be possessed during open season and 10 days thereafter, but not more than 75 in all of waterfowl may be possessed at one time. Game animals, grouse, ptarmigan, hides, heads, and feet of game animals or articles made therefrom; and skins and feathers of game birds legally taken during open season may be possessed and transported at any time within the Territory, and shed antlers of deer, moose, or caribou may be possessed and transported within or out of the Territory at any time without a license.

Interstate transposition: Nonresident citizen or nonresident alien licensee may export 1 moose, 3 deer, 2 caribou (1 from Alaska Peninsula), 2 mountain sheep, 3 mountain goats, and 3 in all of large brown and grizzly bears (2 large brown and grizzly bears if killed in restricted areas on Kodiak-Afognak Islands group or Kenai and Alaska Peninsulas), killed by himself under license coupon and affidavit that he has not violated the game laws; that the big-game animal or part thereof he desires to ship has not been purchased or sold and is not shipped for purpose of being sold; that he lawfully killed the animal and is the owner of the part thereof that he desires to ship; and, if the shipment contains caribou or parts thereof, whether animal was killed on Alaska Peninsula, or if it contains large brown or grizzly bear, or parts thereof, whether such animal was killed in Kodiak-Afognak Islands group, or on Kenai or Alaska Peninsula, respectively.

A nonresident may possess and transport at any time within or out of the Territory skins and feathers of game birds and articles manufactured from hides or hoofs of moose, caribou, deer, or goats legally taken. Any person may without a license export shed antlers of moose, caribou, or deer.

Resident may export for mounting and return in any one year, but not for sale, two heads or trophies of each species of game animal legally killed by himself under shipping license (fee, $1 for each trophy).

A citizen of the United States who has been a resident for at least two years and who is removing his residence from the Territory may export trophies of game animals legally acquired by him under shipping license (fee, $5 for each trophy).

All shipments must be marked with the names and addresses of consignor and consignee and the number of each kind of game contained therein.

Sale: Sale of all protected game prohibited, except that the meat of caribou may be sold by the person killing it, but such meat may not be resold north of summit Alaska Range-Ahklun Mountains except in cooked form, nor south of said summit except in cooked form and then only at road houses having permits from the commission; moose, grouse, and ptarmigan legally killed may be bought and sold at any time north of summit of Alaska Range and Ahklun Mountains, but no person other than the one who killed them may sell them except in cooked form for human food; but meat of moose, grouse, or ptarmigan may not be sold or served by restaurants, road houses, or public or other eating houses located within 5 miles each side of the center line of the Alaska Railroad and its branches; number of animals in excess of season limit allowed in possession under permit of commission. Meat of animals or birds so sold shall not be transported to or possessed in any other part of the Territory. No game animal, game bird, or parts thereof shall be sold to or bought by the owner, master, or employee of any coastal or river steamer or commercial power or sail boat; unlawful to take or possess for serving or to serve any game animal, game bird, or part thereof in any dining car, commercial mess house operated by a cannery, railroad, or contractor, or in any other commercial mess house or other place maintained for serving food regularly to employees thereof, or to serve such game to an employee of any coastal or river steamer or commercial power or sail boat, or for an employee of a railroad, cannery, mine, contractor, or coastal or river steamer or other commercial power or sail boat to possess such game in a dining car or commercial mess house, or in the galley or dining room of any such boat.

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[8] *Alaska:* All hunting is prohibited in Mount McKinley National Park, Katmai and Glacier Bay National Monuments on Kruzof and Partofshikof Islands, or in Eyak Lake closed area, and, except under permit of the Secretary of Agriculture, in Aleutian Islands Reservation (including Unimak Island) and other national bird and animal reservations. An Indian, Eskimo, or half-breed who has not severed his tribal relations, and an explorer, prospector, or traveler may take animals or birds other than migratory birds (except Eskimos and Indians may take auks, auklets, guillemots, and puffins, and their eggs) in any part of Territory at any time for food when in absolute need of food and other food is not available, but he shall not ship or sell any animal or bird or part thereof so taken.

[9] Unlawful to hunt moose on Alaska Peninsula south and west of Kvichak River, Iliamna Lake, and portage from Kamishak Bay to Kakhonak Bay; and mountain sheep or mountain goats on Kenai Peninsula east of longitude 150° (5 miles east of Stalter place on Kenai River); and mountain goats on Baranof and Chichagof Islands.

[10] Large brown or grizzly bears may be killed when about to attack or molest persons or property, or when found within 1 mile of residence or human habitation, and on Kodiak, Afognak, Raspberry, Spruce, and Sitkalidak Islands residents engaged in agricultural pursuits may kill large brown or grizzly bears considered a menace to persons, livestock, or property at any time or place. See "Bag limits and possession" for limit on black bears.

Any person may without a license buy and sell at any time in Territory feathers of wild ducks and geese, lawfully killed or seized and condemned by Federal game authorities, for use in making fishing flies, bed pillows, mattresses, and similar commercial purposes, but not for millinery or ornamental purposes; hides or parts of hides of moose, caribou, deer, and mountain goats legally taken during the open season; shed antlers of caribou, moose, and deer; and skins and feathers of eagles, crows, hawks, owls, ravens, and cormorants.

ARIZONA

Open seasons:[11]	*Dates inclusive*
Deer (male with pronged horn), bear, wild turkey	Oct. 16–Nov. 15.
Peccary or javelina	Nov. 1–Jan. 31.
Squirrel (see exceptions)	Sept. 1–Oct. 31.
Exceptions: Kaibab squirrels in State, and Chiricahua and Arizona tree squirrels south of Gila and Salt River base meridian	No open season.
Quail (Gambel's, scaled)	Nov. 1–Dec. 31.
White-winged dove	July 15–Aug. 31.
Mourning dove	Sept. 1–Dec. 15.
Duck, goose, brant	Oct. 16–Jan. 31.
Wilson's snipe, coot	Oct. 16–Nov. 30.

No open season: Does, spotted fawns, elk, antelope, mountain sheep, bobwhite and Mearns's quail, grouse, pheasant, swans, bitterns, little brown and sandhill cranes, grebes, gulls, herons, loons, band-tailed pigeons, terns, rails, gallinules, and all shorebirds except Wilson's snipe or jacksnipe.

Hunting and fishing licenses: Nonresident: Game and fish, $35; small game and fish, $10; special 15-day fishing, $2.50. Resident: Game and fish, $2.50; fish, $1.25. Alien: Game and fish, $75; small game and fish, $30. Special license, alien applicant for citizenship, game, $25; alien applicant for citizenship, small game and fish, $10. Guide, $10. American-born resident or nonresident under 16 years of age may hunt and fish without license if accompanied by holder of a valid license.

Bag limits and possession: One deer, 1 bear, 1 peccary or javelina, 6 squirrels, 2 turkeys a season; 15 ducks a day or in possession; 2 in all of geese and brant a day or in possession; 15 in all of Wilson's snipe and coots a day or in possession; 20 quail; 20 doves. One male deer, 2 wild turkeys, or one day's bag limit of other game lawfully taken may be possessed for 10 days after close of season.

Interstate transportation: Nonresident licensee may ship one day's bag limit of game or fish under permit attached to his license, and may procure additional license for additional shipment. Game taken outside of the State and legally exported may be possessed in like manner as game taken in the State.

Sale: Sale of all protected game prohibited.

ARKANSAS

Open seasons:	*Dates inclusive*
Male deer (with horns plainly visible above the skull), turkey gobblers (gobblers also Apr. 1–Apr. 30)	Nov. 11–Nov. 16. Dec. 20–Jan. 1.
Squirrel (see exceptions)	July 1–Jan. 1.
Exceptions: In Chicot, Desha, and Lonoke Counties	May 15–June 15. Oct. 1–Jan. 1.
In Ashley, Bradley, Calhoun, Cleveland, Columbia, Dallas, Drew, Garland, Grant, Hot Spring, Lafayette, Lincoln, Ouachita, and Union Counties	Oct. 1–Jan. 1.
In Marion County	No close season.
Quail or partridge (bobwhite)	Dec. 1–Jan. 31.
Duck, goose, brant, Wilson's snipe, coot	Nov. 1–Jan. 31.
Woodcock	Nov. 15–Dec. 15.
Dove	Sept. 1–Dec. 15.
Gallinule	Nov. 1–Nov. 30.
Rail, other than coot and gallinule	Sept. 1–Nov. 30.

No open season: Does, fawns, and wild-turkey hens; bears, prairie chickens, grouse, pheasants (1931); swans, wood ducks, bitterns, sand-hill and whooping cranes, grebes, gulls, herons, loons, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, $15; fish, general, $5; special 15-day (trip), $1.10; resident: Game, $1.10; fish, $1.10. For dog in hunting, $1.50. Issued by State game and fish commission and circuit clerks. Resident hunting license not required of person under 18 years of age. License not required for hunting rabbits, squirrels, or predatory birds and animals or of a person hunting on his own premises. Hunting prohibited on inclosed lands without consent of owner.

County licenses.—Chicot County: Nonresident of State, $50; resident of State: All game, $5.25; game (except deer and turkey), $2.25. Dog (for deer or quail hunting), $1.10. *Desha County:* Nonresident of State, $50; resident of State: All game, $2.50; game (except deer and turkey), $1.10. Dog (for deer or quail hunting), $1. License not required of resident under 16 in Chicot and Desha Counties.

Bag limits and possession: Two deer, 2 turkeys a season; 8 squirrels, 12 quail, 25 doves, 15 ducks, 8 geese, 8 brant, 4 woodcock, 12 Wilson's snipe, 15 in all of rails, coots, and gallinules, a day or in possession. Two days' limit of squirrels, quail, or ducks may be possessed at one time, except while in the field hunting or while returning from a hunt of one day's duration. Possession of migratory game birds permitted during first 10 days of close season.

Interstate transportation: Export of all game prohibited; provided a nonresident, under each of 3 tags attached to his license may ship out 1 day's limit of game; and he may carry out at one time not more than 1 day's limit, but not more than 2 days' limit may be removed from State in any one calendar week; specimen of game may be exported by any person under permit to be mounted, tanned, or made into wearing apparel.

Game taken outside of State and legally exported may be possessed in State at any time.

Sale: Sale of all protected game prohibited.

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[11] *Arizona:* Animals or birds (except migratory birds) that become seriously injurious to agriculture or other interests may be killed under permit of commission.

CALIFORNIA[12]

Open seasons:	*Dates inclusive*
Male deer (except spike bucks):	
In districts 1, 4, 4½, 4¾, 23, 24, 25, and 26	Sept. 16–Oct. 15.
In district 1½	Sept. 1–Oct. 15.
In district 1¾ (mule deer must have more than two branches to each antler)	Sept. 16–Oct. 15.
In districts 2, 2½, and 3	Aug. 1–Sept. 14.
Bear (black, brown) (see exception)	Nov. 15–Feb. 28.
Exception: In districts 1, 1½, 2, and 2½	No close season.
Cottontail and brush rabbits,[13] mountain, valley, and desert quail (see exception)	Dec. 1–Dec. 31.
Exception: Rabbits in district 4¾	No close season.
Mountain and valley quail, district 1½	Nov. 1–Dec. 31.
Grouse	Sept. 15–Oct. 14.
Dove (see exception)	Sept. 1–Sept. 30.
Exception: In districts 4, 4½, 4¾	Sept. 1–Oct. 31.
Sage hen	Aug. 1–Aug. 15.

Open seasons—Continued.	*Dates inclusive*
Duck, goose, brant, Wilson's snipe or jacksnipe, coot (mud hen)	Oct. 1–Jan. 15.[14]
Gallinule	Oct. 1–Nov. 30.

No open season: Does, spike bucks, fawns, elk, antelope, mountain sheep; tree squirrels; sierra hares; pheasants, introduced quail or partridges, turkeys, rail, plovers, yellowlegs, swans, wood duck, eider ducks, auklets, bittern, little brown, sand-hill, and whooping cranes, fulmars, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, band-tailed pigeons, puffins, shearwaters, terns, and all shore birds (except Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Game: Nonresident, $10; aliën, $25 (except those with first papers, fee $10); fish: Nonresident, $3; alien, $5; resident: Game, $2 (resident, under 18, $1); fish, $2. Fishing license not required of persons under 18 years of age. To veterans of Civil War, issued free of charge. Issued by commissioners and county clerks. Unlawful to hunt in inclosure of another without permission of owner. Deer-tag license, $1; commercial club, citizen owner, $25; alien owner, $100; citizen operator, $5; alien operator, $25.

Bag limits and possession: Two deer a season (except in district 1¾, one only); 15 cottontail or brush rabbits a day, 30 a week; 4 grouse a day, 8 a week; 4 sage hens a day, 8 a week; 10 mountain quail a day, 20 a week; 15 valley or desert quail a day, 30 a week; 20 Wilson's snipe or jacksnipe a day, 50 a week; 15 mourning doves a day, 30 a week; 25 ducks a day, 50 a week; 8 geese (honkers) a day, 24 a week; 8 brant a day, 24 a week; 25 coots (mud hens), but not more than 15 gallinules a day, 50 mud hens a week.

Possession in excess of daily limit prohibited. Persons killing deer must retain in possession during open season and 10 days thereafter the skin and the portion of head bearing horns. One day's limit of game birds or animals may be possessed during first 5 days of close season.

Interstate transportation: Export of all protected game prohibited. All shipment by parcel post prohibited.

Game taken outside of the State and legally exported may be possessed in like manner as game taken in the State.

Sale: Sale of deer meat and hides, tree squirrels, and game birds prohibited. Hides of deer taken in a foreign country and cottontail and brush rabbits taken during open season may be sold.

COLORADO

Open seasons:[15]	*Dates inclusive*
Deer (having horns with two or more prongs on each horn)	Oct. 12–Oct. 15.
Rabbit, hare	No close season.
Duck, goose, brant, coot, Wilson's snipe or jacksnipe	Sept. 16–Dec. 31.
Sora and other rails and gallinule (except coot)	Sept. 1–Nov. 30.

No open season: Elk, antelope, mountain sheep, does, fawns, Abert's, black or tufted-eared squirrels, prairie chickens, mountain and willow grouse, sage chickens (1932), quail (bob-white and crested), pheasants,[16] doves (Sept. 1, 1930); partridges, ptarmigan, wild turkeys, swans, wood duck, eider ducks, bitterns, little brown, sandhill, and whooping cranes, grebes, gulls, herons, jaegers, loons, band-tailed pigeons, terns, and all shore birds (except Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Big game, $25; small game, $5; fish, $3. Resident: Big game, $5; small game and fish, $2. No person under 18 is permitted to hunt big game. Fishing license not required of boys under 16 or of women.

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[12] *California:* Of the 72 fish and game districts created under the act of 1917, as amended in 1929, nine (1, 1½, 1¾, 2, 2½, 3, 4, 4½, and 4¾) are properly hunting districts; 14, 15, 23, 24, 25, and 26 are fishing districts but are open to hunting; of the other 63 districts, 37 are game refuges, 9 are special fishing districts, and 17 are commercial fishing districts.

District 1 comprises the eastern half of the Sacramento and San Joaquin Valleys, including all counties not included in districts 1½, 1¾, 2, 2½, 3, 4, 4½, and 4¾.

District 1½ comprises the counties of Del Norte and Humboldt, and that part of Siskiyou west of the Southern Pacific Railroad and Klamath River.

District 1¾ comprises Modoc and Lassen Counties, and Siskiyou County east of Southern Pacific Railroad and Klamath River.

District 2 comprises that part of State south of Humboldt and Tehama Counties, west of Sacramento River and north of San Francisco Bay, including counties of Glenn, Colusa, Yolo, Solano, Napa, Lake, Sonoma, and Marin, and that portion of Mendocino County not included in district 2½.

District 2½ comprises townships in Mendocino County bordering on Pacific Ocean (except townships 11 north, ranges 15 and 16 west) and townships 13, 14, 15, 16, 17, and 18 north, range 16 west.

District 3 comprises the region around the southern portion of San Francisco Bay and the coast counties south of the Golden Gate as far as Ventura, including counties of Contra Costa, Alameda, San Mateo, Santa Clara, San Francisco, Santa Cruz, Monterey, San Luis Obispo, Santa Barbara, and Ventura; also San Benito and western half of San Joaquin, Stanislaus, Merced, Fresno, Kings, and Kern Counties.

District 4 comprises counties in southern California, namely, Los Angeles, Orange, Riverside, and San Bernardino.

District 4½ comprises counties of Mono and Inyo.

District 4¾ comprises San Diego and Imperial Counties.

Districts 23, 24, 25, and 26, all located in district 1, are as follows:

District 23 comprises the drainage area of Lake Tahoe and Truckee River and the head waters of Rubricron and American Rivers, in counties of Placer and Eldorado.

District 24 comprises the drainage area of Silver, Twin, Blue, Meadow, and Wood Lakes in counties of Alpine and Amador.

District 25 comprises the drainage area of Lake Almanor in counties of Plumas and Lassen.

District 26 comprises Sixty Lake Basin, part of Rae Lake, and to south fork of Woods Creek in Fresno County.

[13] Owner or tenant, or person holding written permission from owner or tenant, may kill rabbits on own premises at any time, but rabbits killed in close season may not be shipped or sold.

[14] Waterfowl in districts 4, 4¾, 4a, 4e, 19, 20, 20a, 21, and 22 may be hunted only on Wednesdays, Saturdays, Sundays, legal holidays, and opening and closing days of season, and in district 4a waterfowl may not be hunted on said days before 8 a. m.

[15] *Colorado:* Game and fish commissioner, on petition of board of county commissioners, may suspend or shorten seasons on game in any county or under justifiable conditions may lengthen them.

[16] Pheasants damaging crops may be killed or trapped under permit of commissioner.

Children under 12 not permitted to hunt except on own premises or those of parent or guardian. Guide, $5, in addition to hunting license. Issued by commissioner, county clerks, and other agents. Unlawful to hunt in any inclosure not public land without consent of owner. Unlawful to shoot game from public highway.

Unnaturalized foreign-born residents not permitted to hunt or to own or possess shotgun, rifle, or pistol.

Bag limits and possession: One deer a season, coupon required; 25 ducks, 8 geese, 8 brant, 15 Wilson's snipe, 25 sora, 15 in all of other rails, coots and gallinules a day or in possession. Persons under 12 years of age limited to half this number of birds. Possession permitted during first 5 days of close season. Commissioner may issue permit authorizing storage, possession, and use of game for 90 days after close of open season (except possession of migratory birds limited to 10 days after close of season).

Interstate transportation: Export of all protected game is prohibited; provided, birds, not exceeding the numbers allowed in possession, may be exported under permit from game commissioner (fee, 25 cents for each bird) if permit be attached and packages plainly marked so as to show nature of contents, but not more than two days' limit of migratory birds shall be exported in any one calendar week; edible portion of deer may be exported under $5 permit from the commissioner.

Game taken outside of State and legally exported may be possessed at any time, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season. Importer must obtain from State game and fish commissioner a certificate, fee $1, to import game.

Sale: Sale of all game taken in State prohibited, but game (except migratory birds) coming from without State may be sold under license by indorsement of shipping invoice to purchaser.

CONNECTICUT

Open seasons:[17]	*Dates inclusive*
Deer.[18]	
Hare, rabbit (except European, Belgian, or German hare and jack rabbit, no close season)	Nov. 1–Dec. 15.
Gray squirrel, pheasant, male only (1929)	Oct. 8–Nov. 23.
Woodcock	Oct. 20–Nov. 19.
Duck, goose, brant, coot (mudhen), Wilson's or English snipe	Oct. 1–Jan. 15.
Rail and gallinule, other than coot	Sept. 1–Nov. 30.

No open season: Quail (October 8, 1931), Hungarian partridges (October 21, 1931), ruffed grouse (October 20, 1930); pheasant hens, doves, swans, wood duck, eider ducks, auks, bitterns, fulmars, gannets, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, shearwaters, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, $10.25 (after January 1, 1930, $10.35); game and fish, $11.25 (after January 1, 1930, $14.35); fish, $3.25 (after January 1, 1930, $5.35); resident of State charging fee in excess of $3.25 (after January 1, 1930, $5.35) pays same fee in Connecticut. Resident citizen: Game, $2.25 (after January 1, 1930, $3.25); game and fish, $3.75 (after January 1, 1930, $5.35); fish, $2.25 (after January 1, 1930, $3.35). Issued by city, town, or borough clerk. Hunting license not issued to persons under 16, and fishing license not required of such persons. Resident and his children may hunt or fish during open season without license on land on which he is actually domiciled, if such land is not used for club, shooting, or fishing purposes. Licensee must report amount of game killed, and must wear license button on outer garment. Alien: Not permitted to hunt; fish, $3.25 (after January 1, 1930, $3.35). Taxidermist, $5. Nonresident or alien who owns real estate assessed at not less than $500, or lineal descendant of such nonresident or alien, pays same fee as resident for fishing license.

Bag limits and possession: Five gray squirrels a day, 30 a season; 3 hares or rabbits a day, 30 a season; 2 ruffed grouse a day, 15 a season; 2 pheasants a day, 15 a season; 25 ducks, 8 geese, 8 brant, 4 woodcock, a day; 20 Wilson's snipe, 25 coot, 25 sora, and 25 of all other rails and gallinules, but not more than 15 of any one species a day. Possession of more than daily bag limit of game (except migratory game birds) prima facie evidence of violation. Resident may possess during first 10 days of close season, for his own use and not for sale, game lawfully taken.

Interstate transportation: Export of all protected game prohibited, provided a licensee under permit may export game lawfully killed and possessed, when tagged to show name, address, and license number of shipper, if not for sale; but not more than two days' limit of migratory birds may be exported in any one calendar week.

Game taken outside of State and legally exported may be possessed at any time, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season. Importer must obtain from superintendent of fisheries and game a permit to import game.

Sale: Sale of all protected game prohibited.

DELAWARE

Open seasons:[19]	*Dates inclusive*
Rabbit, hare, quail, partridge	Nov. 15–Dec. 31
Squirrel (fox, black, gray)	Sept. 1–Oct. 15.
Dove (see exception)	Sept. 1–Dec. 15.
Exception: In New Castle County	Sept. 1–Dec. 1.
Woodcock	Nov. 15–Dec. 15.
Duck, goose, brant, Wilson's snipe or jacksnipe, coot	Oct. 16–Jan. 31,
Rail and gallinule other than coot	Sept. 1–Nov. 30.

No open season: Hungarian partridges or pheasants, swans, wood duck, eider ducks, reedbirds, bitterns, sand-hill crane, grebes, gulls, herons, loons, murres, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, $15.50; fish, $5 (not required in Delaware River or Bay). Resident: Game and fish, $1.10 (required outside county of residence). Issued by commission. Resident landowner may hunt or fish during open season on own land without license. Unlawful to hunt on land of another without permission from owner or occupant. Fishing license not required of certain excursionists. Nonresidents who own or lease property at seaside summer resorts and their relatives, friends, and patrons sojourning at such resorts may fish for nongame fish and hunt without license during open season, between June 1 and September 30. Nonresident licensees must wear license-plate or button on outer garment.

Bag limits and possession: Six in all of rabbits, hares, and squirrels, 20 ducks, 8 geese, 8 brant, 20 Wilson's snipe, 4 woodcock, 25 coots, 25 sora, 25 in all of other rails and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules, and not more than 50 in all of sora and other rails combined; 12 birds of any other species a day. Possession of migratory birds permitted during first 10 days of close season; other game during first 5 days thereof.

Interstate transportation: Export of rabbits, squirrels, quail, partridges, doves, woodcock, geese, and brant is prohibited, provided holder of license may export, open to view, 10 rabbits, 10 squirrels, 50 rails, and 20 birds or fowl of any other species a week, lawfully killed, by himself under affidavit that the game is not for sale. Resident may export ducks and snipe. In no event, however, may a person export more than two days' limit of migratory birds in any one calendar week.

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[17] *Connecticut:* Governor may suspend open seasons during time of drought, and on recommendation of board of fisheries and game may close season on partridge or ruffed grouse during 1931.

[18] Owners of agricultural lands, member of family, or employee may kill deer with a shotgun or, under permit, with a rifle, at any time on such lands when deer are damaging fruit trees or growing crops, but such killing or wounding must be reported to the board of fisheries and game within 12 hours.

[19] *Delaware:* Minors under 15 are not permitted to hunt game with shotgun or rifle unless accompanied by an adult lawfully hunting.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale of all protected game prohibited, provided a resident may sell in his own county 20 rabbits a season, lawfully taken by him. Rabbits coming from without State may be sold from November 15 to December 31.

DISTRICT OF COLUMBIA[20]

Open seasons:	*Dates inclusive*
Deer meat (sale or possession)	Sept. 1–Jan. 1.
Rabbit (except English rabbit, Belgian hare), squirrel (sale or possession)	Nov. 1–Feb. 1.
Marsh blackbird	Sept. 1–Feb. 1.
Duck, goose, brant, Wilson's snipe, coot	Nov. 1–Jan. 31.
Woodcock	Nov. 10–Dec. 10.
Rail and gallinule	Sept. 1–Nov. 30.

No open season: Doves, swans, wood duck, reedbirds, bitterns, grebes, gulls, herons, loons, murres, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Bag limits and possession: Twenty-five ducks, 8 geese, 8 brant, 20 Wilson's snipe, 4 woodcock, 25 coots, 25 sora, 25 in all of other rails and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules a day. Possession of migratory birds permitted during first 10 days of close season; quail, November 1 to March 15; ruffed grouse or pheasant (except English or other imported pheasants raised in inclosures, possession unrestricted), and wild turkey, November 1 to December 26; prairie chicken (pinnated grouse), September 1 to March 15.

Interstate transportation: Export of migratory game birds in excess of two days' bag limit in any one calendar week prohibited.

Migratory game birds taken outside of District and legally exported may be possessed during open season where taken and first 10 days of close season. Other game may be possessed during open season in District.

Sale: Sale of all game birds prohibited. Deer, rabbit, and squirrel may be sold during open season.

FLORIDA

Open seasons:[21]	*Dates inclusive*
Deer (male) (see exception)	Nov. 20–Dec. 31.
Exception: In Collier County	July 1, 1934.
Cat squirrel, wild turkey, quail (see exceptions)	Nov. 20–Feb. 15.
Exceptions: Wild turkey, in Collier County	July 1, 1934.
Quail, in Collier County	Nov. 20–Dec. 31.
Duck,[21] [22] goose, brant, Wilson's snipe or jacksnipe, coot, dove[21]	Nov. 20–Jan. 31.
Rail or marsh hen, other than coot and gallinule	Sept. 15–Nov. 30.
Gallinule	Nov. 20–Nov. 30.

No open season: Does, gray, black, or fox squirrels (1932); ruffed grouse, introduced pheasants, and other foreign game birds; swans, wood duck, reedbirds, bitterns, sand-hill and whooping cranes, gannets, grebes, gulls, herons, jaegers, loons, petrels, shearwaters, terns, woodcock, and all shore birds (except Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, $25.50 (State); fresh-water fish, $10.50 (State), $3.25 (county license). Resident: Game, $8 (State); $3.25 (county other than county of residence), $1.25 (county of residence); fresh-water fish, $3.25 (not required in county of residence), $1.25 (county other than county of residence). Duplicate license, fee 25 cents. Issued by county judge. License not required of person under 15, nor of resident Confederate veteran who is entitled to State pension, nor landowner or member of his family in county of residence on own land or that of parent, wife, or child; nor of resident over 65. Guide, $10, alien, $50; issued by State game commissioner. Boats (renting for hunting or fishing): Under 18 feet in length, $2.50 each; 18 to 21 feet, $4 each; 21 to 25 feet, $15 each; over 25 feet, $25 each; issued by State game commissioner. Licensee must report to State game commissioner number and kind of game taken.

Bag limits and possession: One deer a day, 2 a season; 2 turkeys a day, 5 a season; 200 of any other species of game birds or animals a season; 15 cat squirrels, 15 quail, 25 doves, 15 ducks, 5 geese, 5 brant, 15 Wilson's snipe, 20 coots, and 25 in all of rails and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules, a day. Game lawfully taken may be possessed during the open season and first 5 days of close season, but not more than two days' limit of game may be in possession at one time.

Interstate transportation: Export of all protected game prohibited, except nonresident licensee may export game lawfully taken by himself, but not to exceed 2 deer and 5 turkeys a season nor more than two days' limit of other game during any one calendar week.

Sale: Sale of all game prohibited, except that reindeer meat may be brought into State and sold under permit from State game commissioner.

GEORGIA

Open seasons:	*Dates inclusive*
Deer (male with exposed horns)	Nov. 1–Dec. 31.[23]
Bear	Nov. 20–Feb. 28.
Rabbit	No close season.
Cat squirrel, quail,[24] partridge, wild turkey	Nov. 20–Mar. 1.
Opossum	Oct. 1–Feb. 1.
Dove	Sept. 1–Sept. 30. Nov. 20–Jan. 31.
Duck, goose, brant, coot, Wilson's snipe	Nov. 1–Jan. 31.
Woodcock	Dec. 1–Dec. 31.
Rail (marsh hen) and gallinule, other than coot	Sept. 1–Nov. 30.

No open season: Does and fawns, fox squirrels, grouse, pheasants, turkey hens, introduced game birds, swans, wood duck, eider ducks, reedbirds, bitterns, sand-hill and whooping cranes, gannets, grebes, gulls, herons, loons, petrels, shearwaters, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting licenses: Nonresident, $25; resident, State, $3; county, $1 (good only in county of residence). License not required of landowners or tenants and their families with consent of landowner to hunt on own land. Issued by commissioner or county warden.

Bag limits and possession: Two deer, 2 turkeys a season, 15 cat squirrels, 20 quail, 25 ducks, 8 geese, 8 brant, 20 Wilson's snipe, 4 woodcock, 25 coots, 25 sora, and 25 in all of other rails and gallinules, but not more than 15 of any one species; 25 doves a day. Possession of migratory birds, except woodcock, permitted during first 10 days of close season.

Interstate transportation: Export of all protected game prohibited; provided nonresident licensee may take out in personal possession game lawfully killed, but not more than two days' limit of migratory birds may be exported in any one calendar week.

Game taken outside of State and legally exported may be imported under a permit, fee $1, and possessed under a permit, fee $1, in like manner as game taken in State. Permits issued by game and fish commissioner.

Sale: Sale of reedbirds (ricebirds) and all protected game prohibited.

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[20] *District of Columbia:* Hunting prohibited in District by act of June 30, 1906, except on the marshes of the Eastern Branch above Anacostia Bridge and below Aqueduct Bridge on Virginia side of Potomac, but in these areas no birds may be shot within 200 yards of any bridge or dwelling.

[21] *Florida:* State game commissioner on request of county commissioners may extend State seasons on ducks and mourning doves to full period allowed by Federal regulations.

[22] Ducks may be taken on Iamonia, Jackson, and Miccosukee Lakes in Leon and Jefferson Counties only on Monday, Wednesday, and Friday of each week during open season.

[23] *Georgia:* Killing of a deer must be reported to warden of county in which killed or to commissioner of game and fish at Atlanta within 5 days.

[24] Quail in Pierce County may be hunted only on Tuesday and Thursday of each week.

HAWAII

Open seasons:	*Dates inclusive*
Deer	Apr. 1–Oct. 31.
Quail (except bobwhite) in Maui County	Nov. 1–Jan. 31.
In Hawaii County	Dec. 1–Jan. 31.
Pheasant (male) in Maui, Kauai, and Honolulu Counties	Nov. 1–Jan. 31.
In Hawaii County	Dec. 1, Jan. 31.
Wild dove, wild pigeon in Honolulu [25] County	Sept. 1–Dec. 31.
In Hawaii County	July 1–Jan. 31.
In Maui and Kauai Counties	July 1–Dec. 31.

No open season: Native wild ducks and geese, wild peacock, and blue-eyed, top-knot, bar-shouldered, green-winged, and bronze-winged doves, except as permitted by board, hen pheasants, wild African ringneck doves, chachalacas, curassows, guans, guinea fowl, bobwhite quail; quail in Kauai and Honolulu Counties.

Hunting and fishing licenses: County licenses: Nonresident citizen or declarant alien: Game, $10; fish, $2.50; resident citizen: Game, $5; fish, $2.50. Alien: Game, $25; fish, $5. Game licenses issued by city or county treasurer, and fishing, sampan, and boat licenses by fish and game division, Board of Agriculture and Forestry. Permission of owner or occupant required to hunt on lands of another.

Bag limits and possession: *Hawaii County:* Cock pheasants, 5 a day, 25 a season; quail, 15 a day, 30 in 7 consecutive days; doves and pigeons, 20 a day, 50 in 7 consecutive days. *Honolulu County:* Cock pheasants, 3 a day; doves and pigeons, 20 a day. *Kauai County:* Cock pheasants, 3 a day; doves and pigeons, 15 a day. *Maui County:* Cock pheasants, 5 a day, 10 in 7 consecutive days; quail, 10 a day, 25 in 7 consecutive days; doves and pigeons, 15 a day, 45 in 7 consecutive days.

IDAHO

Open seasons:[26]	*Dates inclusive*
Elk, in Clearwater and Idaho Counties	Oct. 1–Nov. 15.
In Franklin County	Oct. 20–Oct. 30.
In Clark, Fremont, Jefferson, Madison, and Teton Counties	Dec. 1–Dec. 15.
Deer, mountain goat, in Adams, Blaine, Boise, Butte, Custer, Elmore, Lemhi, and Valley Counties, and in Idaho County south of Main Salmon and east of Little Salmon	Oct. 6–Oct. 31.
In remainder of Idaho County	Oct. 1–Nov. 15.
In Clearwater County north and west of North Fork and Little North Fork Clearwater River	Oct. 15–Nov. 30.
In rest of Clearwater County	Oct. 1–Nov. 15.
Deer, in Clark, Fremont, Jefferson, Madison, and Teton Counties	Oct. 11–Oct. 20.
In Gem County	Oct. 6–Oct. 31.
In Benewah, Bonner, Boundary, Kootenai, Latah, Lewis, Nez Perce, and Shoshone Counties	Nov. 1–Nov. 30.
In Bannock, Bear Lake, Caribou, Franklin, Oneida, Power, and Twin Falls Counties	Oct. 20–Oct. 30.
In Washington County	Oct. 1–Oct. 31.
Mountain sheep (ram only—see special license) in Valley and Lemhi Counties	Oct. 15–Oct. 25.
Open seasons—Continued.	*Dates inclusive*
Bear (see exception)	No close season.
Exception: In Benewah, Bonner, Boundary, Clearwater, Kootenai, Latah, Lewis, Nez Perce, and Shoshone Counties	Sept. 1–May 31.
Chinese, ring-necked, or Mongolian pheasant, in Ada, Adams, Blaine, Canyon, Cassia, Elmore, Gem, Gooding, Jerome, Lincoln, Minidoka, Owyhee, Payette, Twin Falls, and Washington Counties	Oct. 15–Nov. 25.
In Bannock, Bingham, Bonneville, Fremont, Jefferson, and Madison Counties, and Power County north and west of Snake River	Nov. 1–Nov. 15.
In Clearwater, Idaho, Latah, Lewis, and Nez Perce Counties	Nov. 1–Nov. 30.
Ruffed grouse, native pheasant, blue grouse, in Adams, Blaine, Boise, Cassia, Elmore, Gem, Gooding, Jerome, Lincoln, Minidoka, Owyhee, Twin Falls, Valley, and Washington Counties	Aug. 10–Aug. 20.
In Bannock, Bear Lake, Bingham, Bonneville, Butte, Caribou, Clark, Franklin, Fremont, Jefferson, Lemhi, Madison, Oneida, Power, and Teton Counties	Aug. 24–Sept. 1.
In Clearwater, Idaho, Lewis, and Nez Perce Counties	Sept. 1–Sept. 20.
In Boundary, Bonner, Kootenai, and Shoshone Counties	Oct. 1–Oct. 15.
Sharp-tailed grouse, in Adams, Blaine, Boise, Camas, Cassia, Elmore, Gem, Gooding, Jerome, Lincoln, Minidoka, Owyhee, Twin Falls, Valley, and Washington Counties	Aug. 10–Aug. 20
In Bannock, Bear Lake, Caribou, Franklin, Oneida, and Power Counties	Aug. 24–Sept. 1.
Sage hen or sage grouse, in Adams, Blaine, Boise, Butte, Camas, Cassia, Custer, Elmore, Gem, Gooding, Jerome, Lemhi, Lincoln, Minidoka, Twin Falls, Valley, and Washington Counties	Aug. 10–Aug. 20.
In Bannock, Bear Lake, Bingham, Bonneville, Caribou, Clark, Franklin, Fremont, Jefferson, Madison, Power, and Teton Counties	Aug. 20–Sept. 1
Hungarian partridge, in Benewah, Bonner, Boundary, and Kootenai Counties	Nov. 1–Nov. 15
In Clearwater, Idaho, Latah, Lewis, and Nez Perce Counties	Nov. 1–Nov. 30
Quail, in Lemhi County	Oct. 20–Oct. 31
In Ada, Canyon, Gem, Nez Perce, Payette, Twin Falls, and Washington Counties	Nov. 1–Nov. 15
Dove	Sept. 1–Dec. 15
Duck, goose, brant, Wilson's snipe or jacksnipe, coot (see exception)	Oct. 1–Jan. 15
Exception: In Boundary, Bon-Kootenai, Benewah, and Shoshone Counties	Sept. 16–Dec. 31
Rail and gallinule, other than coot	Sept. 1–Nov. 30

No open season: Deer, elk, mountain goats, mountain sheep (except as above); moose, antelope, caribou, buffalo, spotted fawns, calf elk; quail, grouse (except as above), imported pheasants (except Chinese, ring-necked, or Mongolian pheasants as above); prairie chickens, swans, wood duck, bitterns, little brown and sand-hill cranes, grebes, gulls, herons, loons, terns, and all shore birds (except Wilson's snipe or jacksnipe).

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[25] *Hawaii:* Hunting prohibited in city and county of Honolulu except on Saturdays, Sundays, and legal Territorial holidays.

[26] *Idaho:* State game warden may close season in any county or part thereof on any species of game or fish threatened with extinction.

Hunting and fishing licenses: Nonresident: Game and fish, $50; bird, $10; fish, $5. Alien: Game and fish, $75; fish, $10; gun license, $5. Resident: Game and fish, $2. Special licenses for mountain sheep in Valley and Lemhi Counties: Nonresident, $50; resident, $25. Issued by warden, deputy, or authorized agent. Fishing license not required of minors under 14 years of age; and veterans of Civil War may hunt and fish without a license. Persons under 12 prohibited from possessing gun afield. Taxidermist, $10.

Bag limits and possession: One deer, 1 elk, 1 goat, 1 sheep a season; 6 quail, 4 in all of Chinese, ring-necked or Mongolian pheasants; 8 Hungarian partridges, 4 sage hens, native pheasants, or grouse; 12 ducks, 4 geese, 4 brant a day or in possession; 25 doves, 20 Wilson's snipe, 25 coots, 25 sora and 25 in all of other rails and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules a day. Migratory waterfowl may be stored by owner, under affidavit and storage permit, during open season and 10 days thereafter. Game animals may not be shipped, transported, or carried more than 5 days after close of open season.

Interstate transportation: Export of all protected game prohibited, provided a hunter may export under hunting-license coupon, big game lawfully taken; and one day's limit of game birds may be transported in personal possession but may not be shipped or mailed. Big game once shipped within State may be exported under a 50-cent permit obtained from game warden or deputy. Mounted heads and stuffed birds legally obtained may be exported under a reshipping permit. Shipment of game by parcel post prohibited.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State, if identification tags or shipping or possession permits are attached.

Sale: Sale of all protected game prohibited. Hides, heads, and horns may be sold under permit.

ILLINOIS[27]

Open seasons:	*Dates inclusive*
Rabbit	Nov. 10–Jan. 31.
Squirrel, in northern zone	Sept. 1–Dec. 1.
In central zone	Aug. 1–Dec. 1.
In southern zone	July 1–Dec. 1.
Quail (bobwhite)	Nov. 10–Dec. 10.
Prairie chicken	Nov. 10–Nov. 15.
Introduced pheasant (cocks)	Nov. 10–Nov. 15.
Dove	Sept. 1–Sept. 30.
Duck (except wood duck), goose, brant, coot	Sept. 24–Jan. 7.
Wilson's snipe or jacksnipe	Sept. 24–Dec. 31.
Rail and gallinule, other than coot	Sept. 16–Nov. 30.

No open season: Deer (1939); wild turkeys, introduced pheasant hens, sand grouse, ruffed grouse (partridge), blue, mountain, and valley quail, Hungarian partridges, capercailzie, heath hens, black grouse, woodcock, 1931; swans, wood duck, eider ducks, bitterns, little brown, sand-hill, and whooping cranes, grebes, gulls, herons, jaegers, loons, murres, petrels, terns, and all shore birds (except Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident citizen: Game, $15.50, fish, $1.25; resident citizen; Game, $1; fish, 50 cents. Hunting licenses not issued to aliens, nor to minors under 16 without written consent of parent or guardian. Issued by village, county, or city clerk. Fishing license not required of persons under 21. Owners, their children, and tenants in actual residence may hunt during open season on own land without license. Permission required to hunt on lands of another. Taxidermist, $5.

Bag limits and possession: Ten squirrels, 15 rabbits, 12 quail, 3 prairie chickens, 2 cock pheasants, 15 doves, 15 snipe, 15 in all of coots and gallinules, 15 rails but not more than 25 in all of rails, coots, and gallinules; 15 ducks, 4 geese, 4 brant a day. Limit, in possession, 20 squirrels, 36 quail, 9 prairie chickens, 6 cock pheasants, 25 doves, 50 snipe, 60 coots and gallinules, 60 rails, 60 ducks, 10 geese, 10 brant.

Interstate transportation: Export of all protected game (except rabbit) prohibited; provided, nonresident licenses may take from State 50 game birds or animals, if carried openly for inspection, but not more than two days' limit of migratory birds may be exported in any one calendar week. Resident may carry out game under his license.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale of all protected game (except rabbit, November 10–February 5) prohibited.

INDIANA

Open seasons:	*Dates inclusive*
Rabbit	Oct. 1–Jan. 10.
Squirrel (except red squirrel, no close season)	Aug. 1–Oct. 31.
Quail, ruffed grouse	Nov. 10–Dec. 20.
Prairie chicken	Oct. 15–Oct. 31
Duck, goose, brant, Wilson's snipe or jacksnipe, coot	Oct. 1–Jan. 15.
Woodcock	Oct. 15–Nov. 14.
Rail and gallinule, other than coot	Sept. 1–Nov. 30.

No open season: Deer, Hungarian partridges, introduced pheasants, wild turkeys, doves, swans, wood ducks, bitterns, sand-hill and whooping cranes, gannets, grebes, gulls, herons, jaegers, loons, murres, petrels, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, fish, and trapping, $15.50; fish, $2.25. Resident: Game, fish, and trapping, $1. Issued by clerk circuit court and by superintendent and his agents. Permits to hunt and fish without license issued free to honorably discharged soldiers, sailors, and marines who are residents of State; resident owners of farm land, their children living with them, and tenants residing thereon may hunt during open season on own land without a license. No license required of persons to fish in county of residence. All persons under 18 may fish without license. Permission required to hunt on lands of another.

Bag limits and possession: Ten rabbits, 5 squirrels (except red squirrels, no limit), 15 quail, 5 prairie chickens, 15 ducks, 6 geese, 6 brant a day; 20 Wilson's snipe, 4 woodcock, 25 coots, 25 sora, and 25 in all of other rails and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules a day. Not more than 18 woodcock or three days' limit of other migratory game birds may be possessed at one time by one person. Possession of migratory game birds permitted during first 10 days of close season.

Interstate transportation: Export of deer, quail, grouse, prairie chicken, pheasant, wild turkey, and migratory game birds prohibited, except any licensee may export 15 game birds in the aggregate of all kinds, lawfully taken by himself, each day he hunts in State, but not more than daily limit of any one species, and not more than 2 days' limit in any one calendar week, if carried openly for inspection together with his license or the package is tagged or clearly labeled with names and addresses of shipper and consignee and an accurate statement of number and kind of birds.

Deer, turkeys, and rabbits taken outside of State and legally exported may be possessed at any time; other game legally exported may be possessed in like manner as game taken in State.

Sale: Sale of squirrels (except red squirrels), quail, prairie chickens, introduced pheasants, Hungarian partridges, and migratory birds prohibited. Sale of rabbits prohibited during close season.

Miscellaneous: Shooting on highways or by aid of searchlight prohibited.

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[27] *Illinois: Southern zone* includes Madison, Bond, Fayette, Effingham, Jasper, Crawford, and all counties south. *Central zone* includes Hancock, McDonough, Fulton, Tazewell, McLean, Ford, Vermilion, and all counties south to northern boundary of Southern zone. *Northern zone* includes rest of counties of State.

IOWA

Open seasons:	*Dates inclusive*
Squirrel	Oct. 1–Dec. 31.
Duck, goose, brant, Wilson's snipe or jacksnipe, coot	Sept. 16–Dec. 31.
Woodcock	Oct. 15–Nov. 14.
Rail and gallinule, other than coot	Sept. 16–Nov. 30.

No open season: Deer, introduced pheasants,[28] Hungarian partridges, quail, prairie chickens, ruffed grouse or pheasants, wild turkeys, turtle doves, swans, wood duck, eider ducks, bitterns, little brown, sand-hill, and whooping cranes, grebes, gulls, herons, jaegers, loons, murres, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident or alien, game, $15; fish, $3. Resident citizen, game and fish, $1. Issued by county recorder and authorized agents. Fishing license required of nonresidents over 16 and resident males over 18 to fish in stocked waters. License not granted to persons under 18 without written consent of parent or guardian. Owners of farm lands and their wives or children may hunt and fish on own lands during open season without license. Unlawful to hunt on cultivated or inclosed lands of another without permission from owner.

Bag limits and possession: Fifteen squirrels a day or in possession; 15 ducks, 8 geese, 8 brant, a day, 21 waterfowl in possession; 15 Wilson's snipe, 4 woodcock, 15 each of rails, coots, and gallinules a day, but not more than 15 in all of rails and gallinules a day; 15 of each species in possession. Possession permitted during first 10 days of close season.

Interstate transportation: Export of all protected game prohibited, except that nonresident may take from State not more than 15 game birds or animals, if carried openly for inspection, and if hunting license be shown on request, but not more than 8 woodcock may be exported in any one calendar week.

Game taken outside of State and legally exported may be possessed at any time, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season. After expiration of first 10 days of close season in State, possessor of game must show lawful taking.

Sale: Sale of all protected game prohibited.

KANSAS

Open seasons: [29]	*Dates inclusive*
Fox squirrel	Aug. 1–Jan. 31.
Quail	Nov. 20–Nov. 30.
Prairie chicken (two days)	Oct. 22 and 23.[30]
Dove	Sept 1–Oct. 15.
Duck, goose, brant, Wilson's snipe, coot	Sept. 16–Dec.31.
Rail, other than coot and gallinule	Sept. 1–Nov. 30.
Gallinule	Sept. 16–Nov. 30.

No open season: Deer, antelope, red, gray, and black squirrels, ruffed grouse (partridges), pheasants (English, Mongolian, Hungarian); woodcock; swans, wood duck, eider ducks, bitterns, little brown, sand-hill, and whooping cranes, grebes, gulls, herons, loons, terns, upland plover, and all shore birds (except Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, $15; fish, $3. Hunting license issued by secretary of state and fishing license by county clerks. Resident: Game, $1; fish, $1. Issued by county clerk. Resident landowner or member of family may hunt or fish on own premises during open season without a license. Fishing license not required of males under 18, nor of women. Unlawful to hunt on land of another or on highway or railroad right of way adjacent thereto without consent of owner, unless accompanied by him.

Bag limits [29] and possession: Quail, 10 a day, 25 a season, 5 prairie chickens a day, 10 a season; 15 in all of ducks, Wilson's snipe, coots, and gallinules; 20 doves, 5 in all of geese and brant, 6 rails, a day. Possession of two days' limit of two kinds of game permitted during first five days of close season.

Interstate transportation: Export of all protected game birds prohibited, except that a person under hunting license and affidavit of lawful killing and possession may ship to himself not more than two days' limit of two kinds of game taken by himself. Game of not more than two kinds, and not more than two days' bag limit, taken outside of State and legally exported may be possessed during open season and first five days of close season.

Sale: Sale of all protected game prohibited.

KENTUCKY

Open seasons:	*Dates inclusive*
Rabbit [31]	Nov. 15–Dec. 31.
Squirrel	July 1–Oct. 15.
Quail, ruffed grouse (native pheasant)	Nov. 15–Jan. 1.
Dove	Sept. 1–Dec. 15.
Woodcock	Nov. 15–Dec. 15.
Duck, goose, brant	Nov. 1–Jan. 31.
Wilson's snipe or jacksnipe, coot	Nov. 1–Dec. 31.
Rail and gallinule, other than coot	Sept. 1–Nov. 30.

No open season: Deer, elk (1932); introduced pheasants, Hungarian partridges, wild turkeys (1932); swans, wood duck, bitterns, sand-hill and whooping cranes, grebes, gulls, herons, jaegers, loons, petrels, terns, and all shore birds (except woodcock and Wilson's snipe).

Hunting and fishing licenses: Nonresident or alien, game, $10.50; fish, $2.50. Resident, game, $1; fish, $1. Issued by county clerk. Resident landowner, tenant, and members of families may hunt on own land during open season without license. Unlawful to enter inclosed lands of another for shooting, hunting, or fishing without consent.

Bag limits and possession: Twelve squirrels a day, 24 in possession at one time; 12 quail a day, 12 in possession for each successive day of hunt; 15 doves a day, 15 in possession for each successive day of hunt; 2 ruffed grouse a day; 25 ducks, 8 geese, 8 brant, 4 woodcock, 20 Wilson's snipe, and 25 in all of rails, coots, and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules a day.

Interstate transportation: Export of deer, elk, and all game birds prohibited, except that a hunter may transport game lawfully killed and possessed by him, but not more than two days' limit of migratory birds may be exported in any one calendar week.

Game taken outside of State and legally exported may be possessed during open season in State in like manner as game taken in State.

Sale: Sale of quail, partridges, grouse, introduced or native pheasants, Hungarian partridges, wild turkeys, and migratory birds, wherever killed, prohibited.

LOUISIANA

Open seasons: [32]	*Dates inclusive*
Deer, in Concordia, Avoyelles, Rapides, Vernon, and all parishes north thereof	Dec. 1–Jan. 15.
In parishes south	Nov. 1–Jan. 5.
Bear	Oct. 15–Jan. 5.
Squirrel, chipmunk	Oct. 1–Jan. 15.

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[28] *Iowa:* Upon petition of 150 farmers and landowners in any county who have suffered damage by Chinese, Mongolian, English, or ring-necked pheasants, State game warden may fix an open season for such county not exceeding 5 days during which a person may kill not exceeding 3 such pheasants a day but not more than 10 may be had in possession at any one time.

[29] *Kansas:* Seasons and bag limits may be shortened or reduced when deemed advisable by forestry, fish, and game commission.

[30] Season on prairie chicken fixed by commission.

[31] *Kentucky:* Rabbits may be taken with dogs or traps (except snares) at any time for a person's own use on his own land, but not for sale or barter.

[32] *Louisiana:* Seasons on game may be curtailed in any parish by police juries with consent of commissioner.

Open seasons—Continued.	*Dates inclusive*
Hare, rabbit	Oct. 1–Feb. 28.
Quail	Dec. 1–Feb. 15.
Wild turkey	Mar. 5–Apr. 5.
Woodcock	Dec. 1–Dec. 31.
Dove	Dec. 1–Jan. 31.
Duck, goose, brant, Wilson's snipe, rail, coot, gallinule	Nov. 1–Jan. 31.

No open season: Fawns, elk, prairie chickens, introduced pheasants, swans, wood duck, bobolinks, bitterns, sand-hill and whooping cranes, gannets, grebes, gulls, herons, loons, petrels, terns, upland plover (papabotte) and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game animals and resident game birds, $50; migratory game birds, $25; fish, $5. Resident, $1. Club or association, $5. Alien: General, $50; game birds, $25; fish, $1. Issued by tax collectors. License does not authorize hunting on land of another without his written consent.

Bag limits and possession: Deer, bear, 1 each a day, 5 each a season; squirrels and chipmunks combined, 10 a day, 120 a season; 1 turkey a day, 5 a season; quail, 15 a day, 120 a season; dove, 25 a day, 300 a season; ducks, 25 a day, 300 a season; geese and brant combined, 8 a day, 100 a season; Wilson's snipe, 20 a day, 240 a season; coots, 25 a day, 300 a season; sora, 25 a day, 300 a season; rails and gallinules combined, 25 a day but not more than 15 of any one species of rails (other than sora) and gallinules a day, 300 a season; woodcock, 4 a day, 22 a season.

The daily bag limits include all birds taken by guide or other person who for hire accompanies or assists a hunter in taking them. Game in excess of one day's limit in possession must be tagged. Possession of game birds permitted during first 10 days of close season.

Interstate transportation: Export of all protected game prohibited; provided a nonresident licensee may carry with him out of the State under his license and tag two days' limit of game birds, if not for sale. All game and all packages containing game must be tagged to show kind and number, names of consignor and consignee, initial point of billing, and destination.

Game taken outside of State and legally exported may be possessed at any time, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season.

Sale: Sale of all game (except hares and rabbits during open season and 10 days thereafter) prohibited.

MAINE[33]

Open seasons:[34]	*Dates inclusive*
Bull moose, in Aroostook, Hancock, Knox, Lincoln, Penobscot, Waldo, and Washington Counties (1929)	Nov. 25–Nov. 30.
In remainder of State	No open season.
Deer (see exceptions)	Oct. 16–Nov. 30.
Exceptions: In Androscoggin, Cumberland, Kennebec, Knox, Lincoln, Sagadahoc, Waldo, and York Counties	Nov. 1–Nov. 30.
In Hancock and Washington Counties	Nov. 1–Dec. 15.
Hare, rabbit (see exception)	Oct. 1–Mar. 31.
Exception: In Androscoggin, Cumberland, Sagadahoc, and York Counties	Oct. 1–Feb. 28.
Gray squirrel	Oct. 1–Oct. 31.[35]
Ruffed grouse, partridge, woodcock	Oct. 1–Oct. 31.
Duck, goose, brant, Wilson's snipe, coot (see exception)	Sept. 16–Dec. 31.
Exception: Waterfowl, in Back Bay, Portland, above Grand Trunk Railway bridge	No open season.
Rail, other than coot, and gallinule	Sept. 1–Nov. 30.
Gallinule	Sept. 16–Nov. 30.

No open season: Cow and calf moose, and, except as above, bull moose; caribou, Hungarian partridges, pheasants, black game, capercailzie, cock of the woods, doves, swans, wood duck, eider ducks, auks, bitterns, gannets, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident or alien: All game, $15.15; small game, $5.15. Not issued to person under 18 without consent of parent or guardian. Holder of small-game license may exchange it for big-game license by paying difference in cost. Nonresident may not enter unorganized townships (except public camp sites maintained by Maine Forestry Department) May 1–Nov. 30 and kindle fires while camping, fishing, or hunting, or hunt in such territory during open season unless accompanied by registered guide. Nonresident fishing, $3.15 for 30 days; $5.15 for season; nonresident, ice fishing, $2.15; resident alien fishing, $2.15. Aliens who pay taxes on real estate and who have resided in State two years continuously prior to application may obtain resident hunting and fishing licenses. Taxidermist: Resident citizen, $5; resident alien, $25. Guide licenses: Nonresident, $20; resident, $1. Must not guide more than five nonresidents hunting at one time. Sporting camp, $5. Shipping licenses (within State): Resident, deer, $2; one pair of game birds in seven days, 50 cents. Issued by commissioner.

Resident combination hunting and fishing, $1.15; hunting, 65 cents; fishing, 65 cents. Resident or member of immediate family may hunt or fish without a license during open season on own land used exclusively for agricultural purposes and on which he is actually domiciled. License not required of resident under 18. Issued by city, town, and plantation clerks.

Bag limits and possession: One deer, 1 bull moose a season; 4 ruffed grouse a day, 25 a season; 10 ducks, 8 geese, 8 brant, 2 Wilson's snipe, 4 woodcock a day or in possession, 25 sora, 25 in all of other rails, 25 coots and gallinules but not more than 15 of any one species of rails (other than sora) and gallinules a day. Transportation of migratory game birds must be completed within five days after close of season; reasonable time allowed after close of season to transport other game to home of owner. Deer or moose may not be used or had in possession in lumber camps. Possession of migratory birds limited to first 10 days of close season; deer legally procured may be possessed during close season; moose may be possessed at home of person killing it.

Interstate transportation: Export of all protected game prohibited; provided, a resident of the State, under shipping license (fee, $5) may export game birds lawfully killed by himself, but he must accompany the birds. A nonresident may export, open to view, 1 deer, 1 moose, 5 partridges, 10 ducks, 10 snipe, 4 woodcock and hares lawfully taken by himself, under hunting-license tags, when such tags bear written approval of a warden, deputy, or the commissioner. Nonresident licensee may also ship out 1 pair of game birds a month under a special 50-cent license.

Moose or caribou, or parts thereof, taken outside of State and legally exported may be imported under license of commissioner for consumption or mounting, but not for sale. Deer properly tagged where taken and game birds may be imported under permit of commissioner and possessed in like manner as game killed in State. Permits and shipping tags issued by commissioner of inland fisheries and game.

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[33] *Maine:* Commissioner may make local regulations restricting hunting, and governor may suspend hunting or fishing seasons during drought.

[34] All hunting is prohibited on Kineo Point and Mount Katahdin, Piscataquis County; on Prouts Neck, on Richmond Island, and locally on Cape Elizabeth and in town of Scarboro, Cumberland County; southern point Swan Island; Bartlett Island, Hancock County. (See State laws for details and other protected areas.)

[35] Squirrels protected in parks and in compact or built-up portions of cities and villages.

Sale: Sale of all protected game birds prohibited; unlawful to sell, give away, or accept deer for export. Local provision dealer, under $5 license, may purchase two deer for retail to his local customers. Deer skins and skins with heads attached may be bought and sold by residents under $25 license. Heads, when detached from skins with which purchased, may be sold to licensed taxidermists.

MARYLAND

Open seasons: [36]	*Dates inclusive*
Deer (males having 6-inch antlers), in Allegheny County, and within game reserves inclosed with 7-foot fence in Washington County	Dec. 1–Dec. 15.
In Garrett County	Dec. 1–Dec. 3.
Rabbit or hare, quail (partridge), ruffed grouse (pheasant), English or Mongolian pheasant, wild turkey (see exceptions)	Nov. 10–Dec. 31.
Exceptions: Grouse, in Garrett County	Nov. 10–Dec. 1.
Wild turkey, quail, in Garrett County (1931)	No open season.
Squirrel (see exceptions	Sept. 1–Sept. 30. Nov. 10–Dec. 31.
Exceptions: In Allegheny and Garrett Counties	Oct. 1–Nov. 9.
In Baltimore, Harford, and Howard Counties	Nov. 10–Dec. 31.
Raccoon, opossum	Nov. 2–Jan. 31.[37]
Woodcock	Nov. 10–Dec. 10.
Dove (see exceptions)	Sept. 1–Sept. 30. Nov. 10–Dec. 15.
Exceptions: In Baltimore, Harford, and Howard Counties	Nov. 10–Dec. 15.
In Allegheny and Garrett Counties	Oct. 1–Nov. 9.
Duck, goose, brant, Wilson's snipe, coot	Nov. 1–Jan. 31.[36]
Rails and gallinules, other than coot	Sept. 1–Nov. 30.

No open season: Deer (except as above), elk (1931); Hungarian partridges, reedbirds, swans, wood duck, eider ducks, auks, bitterns, sand-hill cranes, gannets, grebes, gulls, herons, jaegers, loons, murres, petrels, shearwaters, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, $15.50 (fee, $5.50 for State license if applicant owns real estate in Maryland assessed at $500; $1.50 for county license in county where such real estate is located); fish, $5.50. Resident: Game, State, $5.25; county, $1.25; fish, $1.25. Special license for fishing in Deep Creek Lake, Garrett County; resident of county, or person owning property within quarter of a mile of high-water mark of lake may fish in Deep Creek Lake without license; resident of State, nonresident of county, $2.75; nonresident of State, $5.25. Issued by clerks of circuit court of counties—in Baltimore City by clerk, court of common pleas. Permanent resident of Indianhead Government reservation may obtain a resident hunting license for Charles County. Hunting license not issued to persons under 14 without written request of parent or guardian. Angling license required above tidewater of person over 16. License not required of land-owners, tenants, and members of their families fishing from shore of own property. Hunting licensee required to wear tag displayed on middle of back and fishing-license button must be worn in plain view. Owners, tenants, and their children may hunt on own land during open season without license, except that waterfowl may not be hunted on waters of the State without license. Local licenses issued to residents of Cecil and Harford Counties are valid for waterfowl hunting on Susquehanna Flats.

Sinkbox, sneak boat, blind, pusher: Sinkbox, $20.50; sneak boat, $5.50; issued by clerks circuit court of county of which applicant is a resident; booby, brush, or stake blind, $5.50 (not issued except to resident of State or nonresident owner of land bordering on Potomac River or nonresident owner of land bordering on any waters of the State that is assessed at $500 on tax books of Maryland); pushers, $2.50; issued by clerks of circuit court of counties.

Susquehanna Flats: [36] Sinkbox, $20.75; sneak boat, $5.75; issued by clerks of circuit court in Cecil and Harford Counties.

Bag limits and possession: One deer a season; 1 wild turkey a day, 4 a season; 2 in all of English or Mongolian pheasants and ruffed grouse a day, 6 a season; 6 rabbits or hares, 10 squirrels, 10 quail (partridges), 4 woodcock, 25 doves, 20 jacksnipe, 25 coots, 25 in all of rails and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules, 25 ducks, 8 geese, 8 brant a day. Possession of waterfowl permitted during first 10 days of close season.

Interstate transportation: Export of all protected game (except waterfowl) prohibited; provided, a licensed hunter may take out under his license as personal baggage a quantity equal to two days' bag limit of game; provided further, no person may take or ship out more than 50 ducks, 16 geese, and 16 brant in any one calendar week. Waterfowl must be shipped open to view and tagged.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale of quail, ruffed grouse, wild turkeys, or introduced pheasants (whether taken within or coming from without State), and doves and all other migratory game birds prohibited.

MASSACHUSETTS

Open seasons: [38]	*Dates inclusive*
Deer (from sunrise, first Monday in December to sunset the second following Saturday, inclusive) (see exception)	Dec. 2–Dec. 14.
Exception: In Plymouth County	Dec. 2–Dec. 7.
Hare (known as varying or Canada hare or snowshoe or white rabbit) or rabbit (see exceptions)	Oct. 20–Feb. 15.
Exceptions: In Nantucket County	Oct. 20–Feb. 28.
In Dukes County	Nov. 15–Feb. 15.
European hares, in Berkshire County	No close season.
Gray squirrel, quail, male pheasant [39] (see exceptions)	Oct. 20–Nov. 20.

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[36] *Maryland:* Wild-fowl shooting restricted locally as follows: On the Susquehanna Flats south of a line from Concord Lighthouse, Harford County, and Carpenters Point, Cecil County, and north of a line extending from Turkey Point Lighthouse, Cecil County, and half a mile north of Spesutie Island to Oakington, Harford County, but at no time approaching within half a mile of northern end of Spesutie Island or adjacent mainland, hunting allowed only on Mondays, Wednesdays, and Fridays, Nov. 1–Dec. 31, and Mondays, Wednesdays, Fridays, and Saturdays, Jan. 1–31; in Kent County, on Chester River and tributaries, below Chester River bridge on Mondays and Fridays only Nov. 1 to Dec. 31, except between Bay Bush Point on the Wickliffe Farm and Durdings Creek, Mondays, Wednesdays, and Fridays during December; on Patuxent River and tributaries, and in St. Marys County on Wicomico River, Mondays, Wednesdays, Fridays, and Saturdays, Nov. 1–Dec. 31, but not restricted during January except by general provision prohibiting all hunting on Sunday.

[37] Unlawful to trap raccoon or opossum with steel trap or similar device, or, without consent of owner, to cut trees in hunting them.

[38] *Massachusetts:* Governor may suspend open seasons during extreme drought.

[39] Commission may open season on pheasants.

Open seasons—Continued.	*Dates inclusive*
Exceptions: Quail in Essex, Hampden, Hampshire, Middlesex, Nantucket, Norfolk, and Worcester Counties	No open season.
Pheasant in Dukes County	No open season.
Pheasant in Nantucket County	Oct. 20–Nov. 2.
Woodcock	Oct. 20–Nov. 19.
Duck, goose, brant, Wilson's snipe, coot (see exceptions)	Sept. 16–Dec. 31.
Exceptions: In Dukes and Nantucket Counties, and south and east of Cape Cod Canal in Barnstable County	Oct. 1–Jan. 15.
Rail and gallinule, other than coot	Sept. 16–Dec. 15.

No open season: Moose, doves, ruffed grouse, prairie chickens, Hungarian partridges, pheasant hens (English, golden, Mongolian),[39] heath hens, swans, wood duck, eider ducks, auks, bitterns, sand-hill and whooping cranes, fulmars, gannets, guillemots, gulls, herons, jaegers, loons, murres, terns, and all shore birds (except woodcock, and Wilson's snipe or jacksnipe).

Hunting and fishing[40] licenses (Sporting licenses): Nonresident citizen, $5.25. Nonresident, residing in a State affording similar privileges to residents of Massachusetts, who owns real estate assessed at not less than $500, or who is a member of a hunting or fishing club or association incorporated prior to 1907, or who is a guest on written invitation of an incorporated club or association for hunting foxes, fee, $2.25.

Resident citizen, $2.25. Alien, $15.25 (applicant must have resided in State 10 days and own real estate therein to the assessed value of $500). Duplicate of lost or destroyed license, fee, 50 cents. Issued by city and town clerks.

Sporting licenses not issued to minors under 15, and those under 18 must apply in writing and furnish written consent of parent or guardian. A license (fee, 75 cents) to trap quadrupeds may be issued to a minor between ages of 12 and 18.

Resident may hunt during open season without a license on land owned or leased on which he is actually domiciled and which is used exclusively for agricultural purposes, and not for club, shooting, or fishing purposes, and may fish in inland waters bordering such lands. License to fish not required of minors under 18.

Bag limits and possession: One deer a season; 2 hares and 5 rabbits a day or in possession; 5 gray squirrels a day, 15 a season; 4 quail a day, 20 a season; 2 pheasants a day, 6 a season; 4 woodcock a day, 20 a season; 25 ducks (but not more than 15 black ducks), 8 geese, 8 brant, 20 Wilson's snipe, 25 coots, 25 sora, and 25 in all of other rails and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules a day. Resident may possess a deer during first 30 days and other game during first 10 days of closed season if legally taken or acquired by him, and for his personal use only and not for sale; game legally taken and exported from another State or country may be imported and possessed for 10 days after arrival.

Interstate transportation: Export of quail, woodcock, and ruffed grouse taken in State prohibited; provided, a nonresident under his license may take 10 birds into another State according similar privileges, if carried open to view and the commission or district deputy is notified; provided further, a resident may export all game (except quail, ruffed grouse, woodcock), but not more than two days' bag limit of migratory birds may be exported in any one calendar week. No game illegally taken may be exported.

Game taken outside of State and legally exported may be possessed for personal use: Deer for 30 days and other game for 10 days immediately succeeding arrival in State.

Sale: Sale of all game prohibited; provided, deer, moose, caribou, and elk lawfully killed and coming from without State, under warden's tag, may be sold under license at any time. Hares or rabbits lawfully obtained and coming from a State where their sale is not prohibited may be sold during the open season.

Miscellaneous: Deer may be taken with a shotgun only. Unlawful to hunt or kill game with rifle or revolver during open season for deer, or to have dog in woods, except in Dukes and Nantucket Counties.

MICHIGAN

Open seasons:[41]	*Dates inclusive*
Deer (male with horns not less than 3 inches above the skull), bear	Nov. 15–Nov. 30.
Rabbit, varying hare (snowshoe or jack rabbit):	
Upper Peninsula	Oct. 1–Jan. 31.
Lower Peninsula	Oct. 15–Jan. 1.
Fox squirrel, male Chinese or ring-necked pheasant	Oct. 25–Oct. 31.
Ruffed grouse (partridge) (see exception), prairie chicken	Oct. 10–Oct. 20.
Exception: Ruffed grouse (partridge), Lower Peninsula	Oct. 16–Oct. 20.
Woodcock	Oct. 15–Oct. 31.
Duck, goose, brant, coot, Wilson's snipe or jacksnipe	Sept. 16–Dec. 31.
Rails and gallinules, other than coot	Oct. 1–Nov. 30.

No open season: Elk, moose, caribou, doves, quail, squirrels (black or gray), Canada or spruce grouse, hen pheasants, Hungarian partridges, wild turkeys, swans, wood duck, eider ducks, auks, bitterns, sandhill and whooping cranes, gannets, grebes, gulls, herons, jaegers, loons, murres, terns, and all shorebirds (except woodcock and Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Deer and bear, $50; small game, $10; fish, general, $5; special (fish, except brook trout and bass), $2 (after Jan. 1, 1930, fish, $3). Fishing license not required of person under 18. Resident: Deer and bear, $2.50; small game, $1.25; trout, $1; camping party, $3 (1 buck deer by camping party of four or more). Issued by county clerks, director, or deputy. Hunting license issued to persons under 17 and over 12 on application of parent or guardian, who must accompany such minors when hunting. License button must be displayed on outer garment. Residents and minor children may hunt without a license, during open season, small game on own inclosed land on which they reside. Unlawful to hunt on posted farm lands without consent of owner or person in possession.

Bag limits and possession: One deer, 1 bear, a season; 5 fox squirrels a day, 10 in possession, 15 a season; 5 rabbits a day, 5 in possession, in Upper Peninsula, 10 in possession in Lower Peninsula, 50 a season; 5 each of ruffed grouse or prairie chickens a day, 10 each a season; 2 Chinese or ring-necked pheasants a day, 4 a season; 15 ducks a day, 30 in possession, 100 a season; 5 geese or brant a day or in possession, 10 a season; 4 woodcock a day, 8 in possession, 16 a season; 10 Wilson's snipe a day, 20 in possession, 50 a season; 10 coots a day, 20 in possession, 50 a season; 10 rails and gallinules combined a day, 20 in possession, 50 a season. Deer and bear lawfully killed may be possessed during first 30 days of close season, and game birds and other game animals during first 10 days thereof. Camping party of not less than four licensed hunters may, under permit (fee, $3), kill 1 deer for camp purposes.

Interstate transportation: Export prohibited of all protected game. *Exceptions:* (1) Deer and bear may be transported outside of State to reach a point within State. (2) Nonresident licensee may take out as hand baggage, open to view, possession limit of game birds, rabbits, and squirrels, and may ship 1 deer and 1 bear lawfully killed by himself when deer license tag and seal are attached. (3) Heads and skins of deer and bear, green or mounted, lawfully taken, may be exported under permit.

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[39] Commission may open season on pheasants.

[40] License required to fish in inland waters that have been stocked with fish by commission since Jan. 1, 1910.

[41] *Michigan:* Director upon approval of conservation commission may shorten or close the season and otherwise restrict the taking of any species of game for a period of not to exceed 5 years in any county. Such orders may be modified or rescinded when conditions warrant.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale prohibited of all protected game, except rabbits lawfully killed and imported within 15 days, provided heads and skins of deer and bear green or mounted, lawfully taken, may be sold or transported under permit.

MINNESOTA

Open seasons:[42]	*Dates inclusive*
Deer (season closed in odd, open in even years), bear	Nov. 15, 1930.
Varying hare or snowshoe rabbit	No close season.
Squirrel (gray or fox)	Oct. 15–Jan. 1.[43]
Quail	Oct. 15–Nov. 20.
Male ring-necked pheasant (season closed in odd, open in even years)	Oct. 15, 1930.
Prairie chicken or pinnated grouse, white-breasted or sharp-tailed grouse (season closed in even, open in odd years)	Sept 16-Oct 1.
Mourning dove	Sept. 16–Oct. 1.
Duck (except wood duck), goose, brant, coot, Wilson's snipe or jacksnipe	Sept. 16–Dec. 31.
Rail and gallinule, other than coot	Sept. 16–Nov. 30.

No open season: Elk, moose, caribou, black squirrels, ruffed grouse (Oct. 15, 1930); Canada spruce grouse, ring-necked pheasant hens, Hungarian gray partridges, wild turkeys, upland plover, woodcock, black-bellied and golden plovers, swans, wood duck, eider ducks, auks, bitterns, little brown, sand-hill, and whooping cranes, grebes, gulls, herons, jaegers, loons, terns, and all shore birds (except Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident or alien: Big game, $50.25 (includes 25 cents for metal-locking deer seal); small game, $25. Fishing license, $3 (not required of persons under 16 years of age if parent or guardian is licensed). Issued by commissioner, county auditors, and agents. Resident: Big-game animals, $2.25 (includes 25 cents for metal-locking deer seal); small game, $1; fish, 50 cents (family license to fish, $1—includes identification card for each member of family 18 years of age or over); fishing license not required of resident under 18; fish house, $1. Issued by county auditor. Hunting license not required of persons under 18 and owners, lessees, or members of their immediate families may hunt birds or animals (except deer or moose) during open season on own or leased land occupied by them as permanent residence without license.

Any person taking protected wild animals or birds, with or without license, must report to State game commissioner, on or before Jan. 31, number of each kind of game killed during preceding calendar year. Unlawful to enter growing grainfields for purpose of hunting without permission of owner.

Bag limits and possession: One deer a season; 7 squirrels a day, 14 in possession; 5 geese, 12 ducks, and 15 in all of coots, gallinules, Wilson's snipe or jacksnipe, and rails a day, 36 in all in possession, of which not more than 5 may be geese, 120 ducks a season; 10 quail a day, 15 in possession, 30 a season; mourning doves, 9 a day, 30 in possession, 30 a season; 3 ring-necked pheasants a day, 12 in possession, 15 a season, but not more than 15 game birds in all in one day. Possession permitted during first 5 days of close season. Under permit or tags deer may be possessed to February 28, migratory birds for 10 days after close of season, but no game birds may be possessed after January 10.

Interstate transportation: Export of all protected game prohibited, except that nonresident licensee may ship home in open season under his license coupons 1 deer and 25 birds lawfully taken by himself, but not more than the possession limit of any one species a season; not more than 5 geese may be exported by one licensee. Deer hides for tanning and heads for mounting may be exported when tagged with license coupons (deer season closed in odd years.)

Game taken outside of State and legally exported may be possessed at any time under a retaining tag, obtained from State game and fish commissioner, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season.

Sale: Sale of all protected game prohibited; provided, hides of deer legally killed may be sold.

Miscellaneous: Unlawful to carry gun in motor vehicle unless unloaded in both barrel and magazine and taken apart or contained in a case.

Unlawful to keep game in cold storage.

MISSISSIPPI[44]

Open seasons:	*Dates inclusive*
Deer (male)	Nov. 15–Feb. 15.
Bear	Nov. 1–Feb. 28.
Squirrel	Oct. 1–Jan. 1.
Hare, rabbit	No close season.
Quail or partridge (bobwhite)	Nov. 20–Feb. 1.
Wild-turkey gobblers	Jan. 1–Mar. 31.
Dove	Sept. 1–Sept. 30. Nov. 20–Jan. 31.
Woodcock	Dec. 1–Dec. 31.
Waterfowl, Wilson's snipe or jacksnipe, coot, poule d'eau	Nov. 1–Jan. 31.
Rail and gallinule, other than coot	Sept. 1–Nov. 30.

No open season: Does and spotted fawns; turkey hens, ruffed grouse, pheasants, western quail, swans, wood duck, bitterns, sand-hill cranes, grebes, gulls, herons, loons, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, State, $15; county, $10; fish, $2 (county). Resident: Game, State, $3; county, $1 to $3 in discretion of board of supervisors. Issued by sheriff. License not required for hunting rabbits, nor of persons under 16 or over 70. Landowners may hunt during open season on own lands without license. Written permission of owner or agent required to hunt, trap, or fish on posted lands of another.

Bag limits and possession: One deer a day, 3 a season; 1 bear a season; 15 squirrels a day; 2 turkey gobblers a season; 15 quail a day; 25 ducks, 8 geese, 8 brant, 20 Wilson's snipe, 4 woodcock, 25 doves, 25 coots, 25 sora, but not more than 25 in all of rails (other than sora), coots, and gallinules, and not more than 15 of any one species of rails (other than sora) and gallinules a day. Nonresidents limited to not more than 25 migratory game birds of all kinds in one day. Possession of migratory birds permitted during first 10 days of close season.

Interstate transportation: Export of all protected game prohibited, except that a nonresident licensee may take out in personal possession one day's limit of game birds he has lawfully killed.

Game taken outside of State and legally exported may be possessed only during open season in State, but migratory game birds may be possessed only during open season where taken an first 10 days of close season.

Sale: Sale of all protected game (except rabbits) prohibited.

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[42] *Minnesota:* Seasons subject to change by regulations. All hunting prohibited within 3 miles of corporate limits of Duluth, Minneapolis, and St. Paul.

[43] Squirrels protected within corporate limits of any city or village, or within a quarter of a mile thereof.

[44] *Mississippi:* Board of supervisors of any county may by regulation shorten or close seasons, reduce bag limits, or extend other protection to game within the provisions of the law.

MISSOURI

Open seasons:	*Dates inclusive*
Wild turkey	Dec. 1–Dec. 31.
Squirrel	June 1–Nov. 30.
Quail (bobwhite partridge)	Nov. 10–Dec. 31.
Dove	Sept. 1–Dec. 15.
Duck, goose, brant, Wilson's snipe, coot	Sept. 24–Jan. 7.
Woodcock	Nov. 10–Dec. 10.
Rail and gallinule, other than coot	Sept. 15–Nov. 30.

No open season: Deer (1933), ruffed grouse (pheasants), prairie chickens (pinnated grouse), imported pheasants, other introduced game birds swans, wood duck, bitterns, little brown, sand hill, and whooping cranes, grebes, gulls, herons jaegers, loons, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident or alien: Game and fish, $10; fish, $3 (season); 15-day license, $1. Issued by commissioner or county clerk. Resident: Game and fish: State, $2.50; county, $1, good in county or residence or adjoining county; fish (State), $1. Issued by county clerk or license collector. Fishing license not required in county of residence nor of women or minors who are citizens. Owners and tenants of agricultural lands and members of family under 21 residing thereon may hunt without license during open season on own or leased land when used for agricultural purposes only, but may not transport or ship game or fur animals therefrom without a license. Hunting on land of another prohibited without his consent.

Bag limits and possession: One turkey a season; 10 squirrels, 10 quail, 10 doves, 15 ducks, 8 geese, 8 brant, 4 woodcock, 15 Wilson's snipe a day; 15 rails, 15 coots, 15 gallinules, but not more than 25 in all a day or in possession; or 1 turkey, 15 quail, 15 doves, 25 of any other species of birds in possession. Possession of migratory birds permitted during first 10 days of close season, other game during first 5 days thereof.

State hunting license required to possess game.

Interstate transportation: Export of all protected game prohibited, except that not more than two days' limit of game may be exported under resident or nonresident license if carried openly as baggage or express or in owner's possession and accompanied by him.

Game taken outside of State and legally exported may be possessed in like numbers and manner as game taken in State, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season.

Sale: Sale of all protected game prohibited.

MONTANA

Open seasons:[45]	*Dates inclusive*
Deer (male with horns 4 inches above the skull) (see exceptions)	Oct. 15–Nov. 15.
Exceptions: Deer, either sex, in Flathead, Glacier, Lake, Lincoln, Madison, Mineral, and Sanders Counties and in parts of Gallatin and Ravalli Counties	Oct. 15–Nov. 15.
Deer, either sex, in part of Ravalli County	Sept. 20–Oct. 20.
In Blaine, Carbon, Carter, Custer, Dawson, Garfield, Musselshell, McCone, Petroleum, Phillips, Powder River, Prairie, Richland, Roosevelt, Rosebud, Treasure, Valley, Yellowstone, and parts of Big Horn, Fergus, Gallatin, Glacier, and Pondera Counties	No open season.
Elk, in Flathead, Glacier, Madison, Pondera, and parts of Gallatin, Lewis, and Clark, Missoula, and Powell Counties	Oct. 15–Nov. 15.
In Granite County and in part of Powell County	Nov. 10–Nov. 12.
In Jefferson County (bull only)	Nov. 12–Nov. 14.
In parts of Lewis and Clark County	Nov. 1–Nov. 15.
In parts of Lewis and Clark and Teton Counties	Oct. 15–Dec. 1.
In Park County	Oct. 15–Dec. 20.[46]
In part of Ravalli County	Sept.20–Oct.20.[46]
Bear (unlawful to trap)	No close season.
Pheasant, partridge, prairie chicken, fool hen, sage hen, grouse	Sept. 16–Sept. 25.
Duck, goose, brant, Wilson's snipe or jacksnipe, coot	Sept. 16–Dec. 31.
Rail and gallinule, other than coot	Sept. 16–Nov. 30.

No open season: Mountain sheep, mountain goats (except as opened locally by commission); elk (except as above), does and fawns, moose, caribou, antelope, bison or buffalo; quail, introduced pheasants, Hungarian partridges, ptarmigan, wild turkeys,[45] doves, swans, wood duck, bittern, little brown, sand-hill, and whooping cranes, grebes, gulls, herons, loons, band-tailed pigeons, terns, and all shore birds (except Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident citizen: General, $30; game birds and fish, $10; fish, $3.50. Alien: General, $50; fish, $10. Resident citizen,[47] $2. Guide (resident citizen), $10. Shipping (export), 50 cents. Taxidermist, $15. Issued by warden or deputy.

No license required of minors under 15. Alien not holding hunting license required to obtain from warden $25 license to possess firearms.

Bag limits and possession: One buck (1 deer of any age or either sex in Flathead, Gallatin, Glacier, Lake, Lincoln, Madison, Mineral, Ravalli, and Sanders Counties), 1 elk a season; 5 in all of grouse, partridges, prairie chickens, fool hens, pheasants, and sage hens, a day or in possession; 25 ducks, 8 geese, 8 brant, 20 Wilson's snipe, 25 coots, 25 sora, 25 in all of other rails and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules a day. Migratory game birds legally taken may be possessed during open season and first 10 days of close season.

Interstate transportation: Export of all protected game prohibited; provided, game lawfully killed may be exported by a resident under shipping permit (fee, 50 cents) from State warden; a nonresident may export under his license game he has lawfully taken; total shipments under permits or one license may not exceed season's bag limit and not more than two days' limit of migratory birds may be exported in any one calendar week; packages must be labeled to show contents.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale of bears and all protected game prohibited; provided, merchant or hotel or restaurant keeper may sell game, except migratory birds, killed outside the State. Under permit, mounted specimens or hides or heads of game animals or birds lawfully taken may be sold.

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[45] *Montana:* Commission may close season in any district on any species of game threatened with undue depletion from any cause, or reopen such districts, may advance the date of open season on sage grouse in any county, and may specify open seasons and bag limits, locally, on upland game birds on which season is closed.

[46] Commission may declare open seasons on and prescribe regulations governing hunting of elk in any portion of closed area, and on five days' notice close season on elk in Park and Teton Counties, and in part of Lewis and Clark County, and may shorten the season in Ravalli County.

[47] Resident licenses issued to officers of the Forest Service and of the Bureau of Biological Survey, members of United States Department of Agriculture, and to officers and members of the United States Army, Navy, or Marine Corps.

NEBRASKA

Open seasons:	*Dates inclusive*
Squirrel	Oct. 1–Dec. 31.
Rabbit	No close season.
Dove	Sept. 1–Sept. 15.
Duck, goose, brant, coot	Sept. 16–Dec. 31.
Wilson's snipe or jacksnipe	Sept. 16–Nov. 1.
Rails and gallinules, other than coot	Sept. 16–Nov. 30.

No open season: Buffalo, deer, elk, antelope, mountain goats, mountain sheep, quail, partridges, sage hens, introduced pheasants[48] or partridges, prairie chickens, grouse (1931); ptarmigan, introduced game birds, wild turkeys, woodcock, swans, wood duck, bitterns, little brown, sandhill, and whooping cranes, grebes, gulls, herons, jaegers, loons, terns, and all shore birds (except Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, $10.10; fish, $2.10. Alien: Fish, $5.10. Resident, $1.10. Issued by game, forestation, and parks commission and authorized vendors. Licenses required of all persons over 15, but not issued to person under 16 without consent of parent or guardian. Consent of owner required to hunt on private premises. Alien not permitted to hunt, or to own or possess firearms.

Bag limits and possession: Ten squirrels a day, or in possession; 5 pheasants a day or in possession; 20 ducks and coots a day, 40 in possession; 5 geese and brant a day or in possession; 15 doves a day or in possession; 15 Wilson's snipe a day or in possession; 15 rails and 15 gallinules a day or in possession, but not more than 25 in all of rails and gallinules a day; 40 in all of game birds in possession. Possession permitted during first 10 days of close season.

Interstate transporation: Game may be transported by express or baggage during the open season when tagged as required by commission, and shipper's statement that the game is not for sale or profit, and was not taken contrary to law, is furnished commission and a copy attached to shipment; package must be labeled with consignor's license number and kind of game, consigned to shipper, and accompanied by him; shipment must not contain more than 40 game birds or the possession bag limit on any species. Not more than two days' limit of migratory birds may be exported in any one calendar week.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale of all protected game prohibited.

NEVADA

Open seasons:[49]	*Dates inclusive*
Deer (male with branched horns), grouse, mountain quail, sage hen or sage cock, prairie chicken, seasons fixed by fish and game commission.	
Bear, squirrel	No close season.
Cottontail rabbit, mountain hare	Nov. 1–Dec. 31.
Dove	Sept. 1–Dec. 15.
Duck, goose, brant, coot, Wilson's snipe or jacksnipe	Sept. 16–Dec. 31.
Rail and gallinule, other than coot	Sept. 1–Nov. 30.

No open season: Mountain sheep, mountain goats, antelope except as permitted by commission; elk, does, fawns, and spike bucks; quail (except mountain quail) and pheasants[49]; swans, wood duck, bitterns, little brown and sand-hill cranes, grebes, gulls, herons, loons, murres, band-tailed pigeons, terns, and all shore birds (except Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident citizen:[50] Game, $10; fish, $3. Alien, fish, $7.50. Resident citizen: Game, $2.50; fish, $1.50. Deer tags, fee $1, required of holders of licenses to hunt deer. Issued by county clerks and wardens. Aliens prohibited from hunting. No license required of boys and girls under 14.

Bag limits and possession: One deer a season; 5 cottontail rabbits, 2 mountain hares, 10 valley quail, 5 mountain quail, 3 partridges, 3 grouse, 3 pheasants, 5 prairie chickens, 10 sage hens, 15 ducks, 5 geese, 5 brant, 10 snipe, and 25 doves a day or in possession; 25 coots, 25 sora, and 25 in all of other rails and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules a day. One day's limit of game lawfully taken in the open season may be possessed during first 60 days of close season, under permit, except migratory game birds may not be possessed for more than 10 days after close of season. Deer lawfully taken in another State and exported may be personally brought into State by the taker during close season.

Interstate transportation: Export of all protected game prohibited, except holder of a deer-license tag may export a deer legally killed thereunder upon the tag being countersigned by a regular deputy, commissioner, or officer authorized to administer oaths. Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale of deer meat and of all other protected game is prohibited.

NEW HAMPSHIRE

Open seasons:[51]	*Dates inclusive*
Deer, in Coos County	Oct. 15–Nov. 30.
In Carroll County	Nov. 15–Dec. 15.
In Cheshire County	Dec. 1–Dec. 15.
In Grafton County	Nov. 1–Dec. 15.
In rest of State	Dec. 1–Dec. 31.
Hare, rabbit	Oct. 1–Feb. 28.
Partridge, ruffed grouse (see exception)	Oct. 1–Nov. 30.
Exception: In Coos and Cheshire Counties	Oct. 1, 1931.
Pheasant (male) in Hillsborough, Merrimack, Rockingham, and Strafford Counties only	Nov. 1–Nov. 6.
Woodcock	Oct. 1–Oct. 31.
Duck, goose, brant, Wilson's snipe or jacksnipe, coot	Sept. 16–Dec. 31.
Rail, other than coot and gallinule	Sept. 1–Nov. 30.
Gallinule	Sept. 16–Nov. 30.

No open season: Elk, moose, caribou, doves, quail, pheasants (except as above), European partridges; gray squirrels (1935)[52]; swans, wood duck, eider ducks, auks, bitterns, sand-hill cranes; gannets, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game and fish, $15.15; fish, $3.15. Resident: Game and fish, $1.50 (after Jan. 1, 1930, $2). Resident soldiers and sailors more than 70 years of age may obtain license free on application to fish and game commissioner. Fishing licenses not required of children under 16 or of blind persons. Issued by commissioner or his agent in each town, who with few exceptions is the town clerk. Children under 16 may hunt without license when accompanied by licensed parent or guardian. Resident owner of farm lands and his minor children may hunt during open season, on own land without license. Guide: Nonresident, $20; resident, $1. Issued by commissioner.

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[48] *Nebraska:* Game, forestation, and parks commission, upon written request from any county board, may open season on pheasants in such county for 15 days or less between Sept. 16 and Dec. 31. Owner or occupant of farmlands may, under permit, kill pheasants damaging or destroying crops.

[49] *Nevada:* Fish and game commission fixes open seasons on deer with branched horns and upland game birds, and county commissioners may shorten or close season entirely on deer, upland game, or migratory game birds.

[50] Citizen of any State must pay same fee for hunting or fishing license as charged nonresidents by his State of residence.

[51] *New Hampshire:* Governor and council may suspend open season in time of excessive drought or emergency.

[52] Owner of farm lands may take at any time gray squirrels doing actual damage to his crops.

Bag limits and possession: One deer a season; 5 hares a day; 5 ruffed grouse a day, 25 a season; 2 pheasants a day, 5 a season; 4 woodcock a day, 25 a season; 20 ducks, 8 geese, 8 brant, 20 Wilson's snipe, 25 coots, 25 sora, and 25 in all of other rails and gallinules but not more than 15 of any one species of rails (other than sora) and gallinules a day. Deer may be possessed for a reasonable time after close of open season.

Interstate transportation: Export of all protected game prohibited, provided the head, hide, feet, or fur of game quadrupeds, and the plumage or skins of game birds (except migratory birds) legally taken and possessed may be transported in the State without being marked, but under Federal law all interstate shipments must be marked as to contents. Nonresident may take or ship out of the State, under his hunting license, one day's limit of game birds, and under license coupon, one deer. Shipments by common carrier must have attached tag showing number and kind of game, names of consignor and consignee, and point of shipment and destination, and the shipment or transportation of game must be indorsed on the back of shipper's license.

Deer must be tagged with license coupon before being moved.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale of all migratory birds prohibited. Sale for food purposes prohibited of the dead bodies of birds belonging to a family any species or subspecies of which is native to and protected by the State; provided deer, hares, and rabbits may be sold during the open season for consumption as food only within State.

NEW JERSEY

Open seasons:	*Dates inclusive*
Deer [53] (male, with horns not less than 3 inches long)	Dec. 17–Dec. 21.
Raccoon	Oct. 1–Dec. 15.
Rabbit,[54] gray,[54] fox, and black squirrels, quail, ruffed grouse (partridge), prairie chicken, English or ring-necked pheasant cocks (see exceptions)	Nov. 10–Dec. 15.
Exceptions: Quail in Bergen, Essex, Hudson, Hunterdon, Morris, Passaic, Somerset, Sussex, Union, and Warren Counties	Mar. 15, 1933.
Ruffed grouse in Essex, Hunterdon, Mercer, Middlesex, Monmouth, Somerset, and Union Counties	Mar. 9, 1932.
Ruffed grouse in Warren, Sussex, Morris, Passaic, and Bergen Counties	Nov. 10, 1930.
Duck (except wood duck and eider ducks), goose, brant, Wilson's snipe or jacksnipe, coot	Oct. 16–Jan. 31.[55]
Woodcock	Oct. 15–Nov. 14.[55]
Rail (marsh hen), other than coot and gallinule	Sept. 1–Nov. 30.[55]
Gallinule	Oct. 16–Nov. 30.[55]

No open season: Does and fawns, wild turkeys, English or ring-necked pheasant hens, Hungarian partridges, reedbirds, doves, swans, wood duck, eider ducks, auks, bitterns, little brown, sandhill, and whooping cranes, fulmars, gannets, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident and alien: Game and fish, $10.50; fish (in fresh waters), $5.50. Resident male citizen above age of 14: Game and fish, $1.65. Special license to hunt woodcock from Oct. 15 to Nov. 9, fee $2, required in addition to regular hunting license; issued by commission. When applied for by parent or legal guardian, in discretion of commission, license may be granted to citizen between ages 10 and 14 to hunt when accompanied by adult holder of a general license: Fee, $1; issued only by commission. All other licenses, except as indicated, issued by county, city, or town clerk, salaried warden, or registrar of licenses. Licensee required to wear in a conspicuous place on his outer clothing a license button. Occupant of farm and immediate members of his family residing thereon with him may hunt or fish on such farm during open season without license. Hunting on occupied posted lands of another prohibited.

Alien prohibited from hunting or owning shotgun or rifle unless he is owner of real property in New Jersey to the value of $2,000 above all incumbrances, in which case he may obtain nonresident and alien license.

Bag limits and possession: One deer a year; 2 English or ring-necked pheasant cocks a day, 30 a season; 6 rabbits, 6 gray squirrels, 10 quail, 3 ruffed grouse, 4 woodcock, 25 ducks, 8 geese, 8 brant, 20 snipe, 25 sora, and 25 in all of other rails (marsh hens), coots, and gallinules but not more than 15 of any one species of rails (other than sora) and gallinules a day or in possession. Deer carcasses from another State or a State game preserve may be possessed at any time if properly tagged to show where killed; possession of other game permitted during first 10 days of close season.

Interstate transportation: Export of all protected game (except deer) prohibited, except that a nonresident licensee in one day may carry from State the daily bag limit of game, if open to view, but not more than two days' limit of game may be exported in one calendar week.

Game taken outside of State and legally exported may be possessed at any time, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season.

Sale: The sale of deer, squirrels, and all game birds is prohibited; rabbits may be sold during open season and 10 days thereafter; cottontail rabbits, Belgian hares, and jack rabbits legally killed and coming from another State may be sold at any time.

Miscellaneous: Unlawful to use shotgun or rifle holding more than two cartridges or that may be fired more than twice without reloading.

NEW MEXICO

Open seasons: [56]	*Dates inclusive*
Deer (with horns at least 6 inches in length), wild turkey, grouse, Abert's and Arizona gray squirrels	Nov. 10–Nov. 20.
Bear	Oct. 10–Oct. 31.
Quail (except bobwhite)	Nov. 1–Dec. 31.
Prairie chicken	Sept. 1–Sept. 5.
Turtle dove and white-winged dove	Sept. 1–Dec. 15.
Duck, goose, brant, Wilson's snipe, coot	Oct. 16–Jan. 31.
Rail and gallinule, other than coot	Sept. 1–Nov. 30.

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[53] *New Jersey:* Wild deer may be taken only with shotgun not smaller than 12 gauge, which may not be loaded with a bullet or other missile larger than buckshot. Killing of a deer must be reported to commission or county warden within 48 hours. Landowner or his authorized agent may kill deer on his own cultivated land at any time; carcass of deer so killed is the property of the commission, and killing must be reported within 48 hours.

[54] Rabbits and gray squirrels may be killed or trapped on own premises by farmers or fruit-growers under permit from commission.

[55] Migratory game birds may not be killed at any time on Shark River, or the shores thereof, in Monmouth County.

[56] *New Mexico:* Commission may close season in any locality on any species, and may prohibit all hunting, in periods of extreme forest-fire danger, at such times and places as may be necessary.

No open season: Does, Sonoran deer, elk, mountain sheep, mountain goats, antelope, buffalo, bobwhite quail, pheasants, ptarmigan, sage hens, swans, wood duck, bitterns, little brown, sandhill, and whooping cranes, grebes, gulls, herons, loons, band-tailed pigeons, terns, and all shore birds (except Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Big game, bird, and fish, $35.25; big game and bird, $30.25; big game, $25.25; bird, $10.25; fish: General $3; limited, $1.25. Resident: Big game, bird, and fish, $5; big game and bird, $4.50; bird and fish, $4.50; big game, $3; bird, $2.50; fish: General, $2; limited, $1.25; guide, $5.25; duplicate, $1. Issued by county clerks and deputies designated by State warden. Fishing license not required of children under 14. Alien resident of New Mexico or an adjoining State not permitted to hunt or to own or possess shotgun or rifle in State.

Bag limits and possession: One deer, 1 bear, 5 squirrels, 2 wild turkeys, 10 prairie chickens, 5 grouse, a season or in possession; 15 quail, 5 prairie chickens a day or in possession; 20 doves, 20 ducks, 8 geese, 8 brant, 20 Wilson's snipe, 25 coots, 25 sora, and 25 in all of other rails and gallinules but not more than 15 of any one species of rails (other than sora) and gallinules a day or in possession. Possession permitted during open season and first 10 days of close season. Under permit, game, except migratory birds, may be held in storage for first 90 days of close season; migratory birds may be so held for a period of 10 days.

Interstate transportation: Export of all game taken in the State prohibited, except the following permits are required to ship game out by common carrier: Fee, $1.25 for 1 deer, 1 bear, and 2 turkeys, and 50 cents for bag limit of other birds and fish.

Game taken outside of State and legally exported, when accompanied by permit or proof of lawful possession, may be possessed under permit obtained from State game and fish warden during open season and first 90 days of close season, but migratory game birds may be possessed only during open season where taken and first 10 days of close of season.

Sale: Sale of all protected game taken in the State prohibited.

NEW YORK

Open seasons: [57]	*Dates inclusive*
Deer (with horns not less than 3 inches long):	
In Adirondack region [58] (except in towns of Salem, White Creek, and Jackson, in Washington County, Nov. 7–Nov. 19)	Oct. 15–Nov. 15.
In Ulster, Sullivan, Rensselaer, Delaware, Columbia, Orange, and Dutchess [59] Counties	Nov. 1–Nov. 15.
In Greene County	Nov. 1–Nov. 8.
In rest of State	No open season.
Bear	Oct. 15–Nov. 15.
Varying hare [57]	Oct 15–Mar. 1.

Open seasons—Continued.	*Dates inclusive*
Cottontail rabbit [57]	Oct. 15–Jan. 31.
Squirrel (black, gray)[57,60]	Oct. 15–Nov. 15.
Quail, in Dutchess, Greene, Orange, Putnam, Rensselaer, Sullivan, and Westchester Counties only	Nov. 15–Nov.30.
Pheasant, male only [57] (4 days only)	Oct 24 and 31. Nov. 2 and 9.
Waterfowl, Wilson's snipe or jacksnipe, coot	Sept. 24–Jan. 7.
Woodcock	Oct. 1–Oct. 31.
Rail and gallinule, other than coot	Sept. 24–Nov. 30.

No open season: Elk, moose, caribou, antelope, fawns; fox squirrels, grouse partridges; Hungarian or European gray-legged partridges, doves, quail (except as above), swans, wood duck, eider ducks, auks, bitterns, sand-hill and whooping cranes, fulmars, gannets, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting, trapping, and fishing licenses (combined): Nonresident: $10.50; fish only, $5.50. Resident, $1.25. Special deer license: Nonresident or alien, $10.50; resident, $1.25. Issued by county, city, town, and village clerks where population exceeds 5,000; elsewhere by department and inspectors and protectors; license not issued to minor under 16. Indian resident or member of Six Nations residing on any reservation wholly or partly within State, $1.25. Only licensed Indians residing on a reservation may hunt thereon. Licensee required to wear button. Fishing license not required of women who are bona fide residents of State nor of minors under 16. Owners or lessees, and members of immediate families who are citizens actually occupying cultivated farm land may hunt thereon without license during open season. Guide (required in forest reserve counties), license fee, $2; issued by conservation department. Alien not permitted to hunt except under special license from conservation department, or to own or possess shotgun or rifle.

Bag limits: One deer, 1 bear, 3 male pheasants a season; 4 woodcock a day, 24 a season; 6 varying hares or rabbits, 5 squirrels, 25 ducks, 8 geese, 8 brant, 25 in all of rails, coots, and gallinules, but not more than 15 of any one species, 20 Wilson's snipe or jacksnipe a day.

Local bag limits: Quail, 4 a day, 10 a season, in Dutchess, Greene, Orange, Putnam, Rensselaer, Sullivan, and Westchester Counties.

Possession: Deer, bear, squirrel, grouse, and pheasant during open season and 5 days thereafter; migratory game birds during open season and 10 days thereafter. Deer and bear properly tagged may be possessed under $1 permit to Feb. 1.

Interstate transportation: Export of game and birds prohibited except that any person may export 1 deer, 1 bear, and one day's limit of other game in one day during open season by means other than parcel post. The taker may export in one day by common carrier, except parcel post, one day's limit when accompanied by permit, which shall show contents of package. Head, hide, and feet of animals and plumage or skin of game birds legally taken may be exported at any time.

Game taken outside of State and legally exported may be brought into State during open season therein and possessed the same as if taken in State. Migratory game birds may be possessed during open season where taken and first 10 days of close season. Importation permit, fee $1, obtained from conversation department, required to import game during close season, and then game birds must be accompanied by taker, while quadrupeds bearing New York importation tags may be shipped by common carrier, but not by parcel post. Game other than migratory birds imported under importation permit may be possessed at any time by permit holder for private consumption.

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[57] *New York:* Commission by order may further restrict taking or possession of game. Open seasons on upland game have been restricted to the following periods or closed as indicated: *Squirrel* (black, gray), in Genesee, Niagara, Ontario, Orleans, Rockland, and Seneca Counties no open season. *Cottontail rabbit*, in Erie County, Oct. 15–Dec. 31; in Genesee County, Oct. 15–Dec. 31; in Niagara County, Oct. 15–Jan. 1; in Richmond County, Nov. 15–Dec. 31; in Rockland County, Nov. 1–Dec. 31. *Varying hare*, in Fulton and Onondaga Counties, Oct. 15–Jan. 31; in Richmond County, Nov. 15–Dec. 31; in Cattaraugus and Genesee Counties, no open season. *Pheasant*, in Delaware and Essex Counties, no open season.

[58] The Adirondack region comprises the counties of Clinton, Essex, Franklin, Fulton, Hamilton, Herkimer, Jefferson, Lewis, Oneida, Oswego, Saratoga, St. Lawrence, Warren, and Washington.

[59] In Dutchess County deer may be taken only on own land by owner or lessee, or member of his immediate family, by use of shotgun loaded with missile not smaller than buckshot.

[60] In corporate limits of city or village squirrels may be taken only under permit of commission.

Sale: Sale of all game, except varying hares and rabbits, prohibited; varying hares and rabbits legally taken in State may be sold during open season, and when brought from without the State may be sold at any time.

Head, hide, and feet of quadrupeds legally taken and possessed may be sold at any time.

Miscellaneous: Hunting prohibited on lands supplying any municipality with water or on public highways, except public highways within forest preserve counties.

NEW YORK—Long Island

Open seasons:	*Dates inclusive*
Squirrel (black, gray), quail, pheasant (male only)	Nov. 1–Dec. 31.
Varying hare	Oct. 15–Mar. 1.
Cottontail rabbit	Nov. 1–Dec. 31.
Waterfowl, Wilson's snipe or jacksnipe, coot, mud hen	Oct. 16–Jan. 31.
Woodcock	Oct. 1–Oct. 31.
Rail and gallinule, other than coot	Sept. 24–Nov. 30.

No open season: Deer, fox squirrels, ruffed grouse, partridges; doves, swans, wood duck; eider ducks, auks, bitterns, sand-hill and whooping cranes, fulmars, gannets, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Bag limits and possession: Six quail a day, 40 a season; 4 male pheasants a day, 30 a season. For other bag limits see New York.

Hunting licenses, interstate transportation, sale, miscellaneous (see New York).

NORTH CAROLINA

Open seasons:[61]	*Dates inclusive*
Deer (male), bear [62]	Oct 1–Jan. 15.
Rabbit,[62] quail, wild turkey	Nov. 20–Feb. 15.
Squirrel, east of and including Person, Orange, Chatham, Moore, Richmond, and Scotland Counties	Oct. 15–Jan. 15.
In rest of State	Sept. 15–Jan. 1.
Ruffed grouse, Mongolian, Chinese, or ring-necked pheasant	Dec. 1–Mar. 1.
Dove	Nov. 20–Jan. 31.
Woodcock	Dec. 1–Dec. 31.
Duck, goose, brant, coot, Wilson's snipe or jacksnipe	Nov. 1–Jan. 31.[63]
Rail (except coot and gallinule)	Sept. 1–Nov. 30.
Gallinule	Nov. 1–Nov. 30.

No open season: Buffalo, elk; does (1931), swans, wood duck, reedbirds, auks, bitterns, gannets, grebes, gulls, herons, jaegers, loons, murres, petrels, shearwaters, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident [64] or alien: Game, $15.25;[64] game and fish, $17.25; game and fur animals, $35.25; fish, $3.10. Nonresident owning land in State may obtain license to hunt thereon, fee, $5.25. Resident (State licenses), game, $3.25; game and fish, $4.50; game and fur animals, $5.25; fish, $2.10. County licenses: Game, $1.25; game and fur animals, $3; fish, $1.10 where required by board of county commissioners; daily permit, 50 cents. Hunting guide license, not exceeding $10, according to classification. Issued by superior court clerks, wardens, and deputies. Person under 16 who is member of family resident of State may hunt under license of his parent or guardian; nonresident minor child of a resident may procure and use resident hunting license when actually visiting such resident parent. Resident landowner and dependent member of his family under 21 may hunt on own land during open season without license. Lessee of farm for cultivation may hunt thereon without license. License not required for fishing in Atlantic Ocean, the sounds, or other large bodies of water as designated by commission, nor of land owner or member of family under 21 for fishing in waters on his own land, nor of person under 16. Fishing licensee must wear license button. All licenses expire August 1.

Bag limits and possession: Two deer a day or in possession at one time, 4 a season; 2 wild turkeys a day or in possession at one time, 5 a season; 10 squirrels, 10 quail, 25 in all of ruffed grouse and introduced pheasants, 4 woodcock, 25 doves, 25 ducks, 8 geese, 8 brant, 20 Wilson's snipe or jacksnipe, and 25 in all of rails, coots, and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules a day.

The game allowed in possession at one time is restricted to one day's limit on deer and wild turkeys and three days' limit on other game animals and birds.

Rabbits and squirrels lawfully taken may be possessed during open season and first five days of close season. Other game animals and birds may be possessed during open season and first 10 days of close season.

Interstate transportation: Export of all protected game (except rabbits during open season) prohibited, except that a nonresident licensee, under permit from State warden may export not more than 2 male deer and 2 wild turkeys a season and not more than two days' limit of other game animals and birds a calendar week in any manner except by parcel post, if outside of package in which such game is transported is clearly marked with names and addresses of consignor and consignee and an accurate statement of number and kind of game contained therein.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale of all protected game prohibited except rabbits and squirrels during open season.

NORTH DAKOTA [65]

Open seasons:	*Dates inclusive*
Prairie chicken (pinnated grouse), sharp-tailed (white-breasted) grouse, Wilson's snipe	Sept. 16–Oct. 16.
Ruffed grouse in Bottineau, Cavalier, Pembina, and Rolette Counties	Oct. 7–Oct. 16.
Woodcock	Oct. 1–Oct. 16.
Duck, goose, brant	Sept. 16–Dec. 1.

No open season: Deer, elk, moose, antelope, quail, ruffed grouse, except as above, sage hens, English and Chinese ring-necked pheasants, Hungarian partridges, doves, rail, coot, gallinule, swans, wood duck, bitterns, little brown, sandhill, and whooping cranes, grebes, gulls, herons, loons, shearwaters, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

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[61] *North Carolina:* On petition of 25 or more reputable citizens and after public hearing, duly advertised, department of conservation and development may change, close, or reopen seasons within the dates specified for State or any county or district thereof or change the bag limits when special circumstances make such changes desirable and may designate days in each week on which migratory waterfowl may not be taken.

[62] Department of conservation and development may change seasons on bears and rabbits.

[63] Rest days prescribed for waterfowl by certain county laws. Special regulations affecting waterfowl in Currituck, Dare, and Hyde Counties may be obtained from clerks of counties named.

[64] Boards of county commissioners may prescribe additional license fees for nonresidents hunting in their respective counties.

[65] *North Dakota:* The governor, on recommendation of game and fish commission, may by order close or open seasons, fix bag limits, or prescribe manner in which game may be taken, but such orders may not extend the open seasons or other provisions of the Federal regulations on migratory birds.

Hunting and fishing licenses: Nonresident: Game, $25; fish, $3. Resident: Game, $1.50; fish, 50 cents; taxidermist, $1. Issued by commissioners, deputy, or county auditor. Fishing license not required of resident under 16 and nonresident under 12. Aliens not permitted to hunt. Person or member of family permanently residing with him may hunt, trap, or fish without license during open season on own lands or lands cultivated by him. Resident license may be issued to settler. No person permitted to enter cultivated or posted lands without consent of owner.

Bag limits and possession: Five prairie chickens, sharp-tailed grouse, each or all combined a day, 10 each or all in possession at one time; 5 ruffed grouse a day, 15 in possession; 15 snipe, woodcock, ducks, geese, each or all combined a day, but not more than 8 geese, 8 brant, or 4 woodcock, 30 in possession but not including more than 16 geese; 25 coots, 25 sora, 25 in all of rails and gallinules but not more than 15 of any one species of rails (other than sora) and gallinules a day. Resident licensee under permit may retain not to exceed 20 pinnated or sharp-tailed grouse, 30 waterfowl, but not more than 50 birds in all during first 5 days of close season.

Interstate transportation: Export of all protected game prohibited, except that nonresident licensee may carry with him from State under license tag 2 days' limit of game, if open to view and labeled with his name and address and number of his license. Not more than two days' limit of migratory birds may be exported in any one calendar week.

Game taken outside of State and legally exported may be possessed under storage permit, obtained from secretary, game and fish commission, in like numbers and manner as game taken in State, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season.

Sale: Sale of all protected game prohibited, except that hides, heads, and trophies of big game lawfully taken may be sold at any time.

OHIO

Open seasons:	*Dates inclusive*
Hare, rabbit	Nov. 15–Jan. 1.[66]
Squirrel	Sept. 15–Oct. 1.
Cock pheasant (introduced), Hungarian partridge	Nov. 15–Nov. 25.
Duck, goose, brant, Wilson's snipe, coot	Sept. 16–Dec. 31.
Woodcock	Oct. 15–Nov. 14.
Rail, other than coot and gallinule	Nov. 1–Nov. 30.
Gallinule	Sept. 16–Nov. 30.

No open season: Deer, quail, ruffed grouse, hen pheasants, doves, swans, wood duck, eider ducks, bitterns, sand-hill and whooping cranes, grebes, gulls, herons, jaegers, loons, murres, petrels, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident citizen: Game, $15.25; fish, $2.25 (rod and reel). Resident citizen: Game, $1.25; fish, $1.10 (rod and reel). Issued by county and township clerks. Rod and reel license not required of persons under 18. Persons under 16 when hunting with a gun must be accompanied by adult. Owners, tenants, or their children may hunt or fish without license during open season on own or leased lands. Written permission required to hunt on land of another.

Bag limits and possession: Four squirrels and 5 rabbits a day or in possession; 2 cock pheasants a day, 4 in possession; and 6 Hungarian partridges, 15 Wilson's snipe, 4 woodcock, 8 geese, 25 ducks, 25 coots, 25 sora, and 25 in all of other rails and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules, and not more than 25 coots and gallinules a day. Waterfowl, coots, and gallinules may be possessed during first 10 days of close season.

Interstate transportation: Export prohibited of all protected game (except rabbit) taken in State; provided, a nonresident may take with him from State under his hunting license 25 game animals killed by himself. Packages containing game or fur-bearing animals or parts thereof must be marked to show contents, initial point of billing, and names and addresses of consignor and consignee.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale prohibited of all protected game (except hare or rabbit during open season).

OKLAHOMA

Open seasons:	*Dates inclusive*
Bear.[67]	
Squirrel	May 15–Jan. 1.
Quail	Nov. 20–Jan. 1.[68]
Prairie chicken, in Beckham, Ellis, and Roger Mills Counties only (1929)	Sept. 9–Sept. 13.
Duck, goose, brant, Wilson's snipe or jacksnipe, coot	Oct. 16–Jan. 31.
Dove	Sept. 1–Dec. 15.
Woodcock	Nov. 15–Dec. 15.
Rail and gallinule, other than coot	Sept. 1–Nov. 30.

No open season: Deer (1931); antelope. wild turkeys, prairie chickens, imported pheasants, swans, wood duck; bitterns, little brown, sandhill, and whooping cranes, grebes, gulls, herons, loons, band-tailed pigeons, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Game: Nonresident, $15. Nonresidents in States bordering on Red River may procure special license (fee, $2.50) to hunt migratory waterfowl on Red River within borders of Oklahoma. Alien, $25; resident citizen, $1.25. Fish: Nonresident, $5; nonresident tourist, 10 days, $1.25; resident (to use rod and line for game fish), $1.25. Issued by warden, deputy, or county clerk. A person may hunt without license during open season on own or leased premises actually occupied by him. Fishing license not required of any person under 16 nor of women. Application of persons under 14 for a hunting license must be approved in writing by parent or guardian. Women required to have hunting licenses. Unlawful to shoot on or across highway or railroad right of way. Unlawful to hunt on lands of another without owner's permission.

Bag limits and possession: Ten squirrels a day; 10 quail a day, 50 a season; 6 prairie chickens a day, 12 in possession; 10 ducks a day, 50 a season; 4 geese a day, 12 a season; 8 brant a day; 20 Wilson's snipe a day, 25 coots, 25 sora, and 25 in all of other rails and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules, 25 doves, and 4 woodcock a day. Possession of game permitted during first 10 days of close season, and trophies or specimens of game lawfully taken may be possessed at any time.

Interstate transportation: Export prohibited of all protected game, but nonresident licensee may carry to his home two days' bag limit of game birds if license permit is attached.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale prohibited of all protected game.

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[66] *Ohio:* Landowners, tenants, and employees may take hares or rabbits, when doing substantial damage to crops, trees, or shrubbery, at any time except on Sunday.

[67] *Oklahoma:* Bear in Blaine, Caddo, Comanche, Kiowa, and Major Counties, no open season; in rest of State, no close season.

[68] Quail may not be hunted except on Monday, Wednesday, and Friday of each week during open season and on Thanksgiving Day and on Christmas and New Year's Days or the preceding Saturdays if these fall on Sundays.

OREGON[69]

Open seasons:	*Dates inclusive*
District No. 1,[70] west of Cascades:	
Deer (male, with forked horns)	Sept. 15–Oct. 20.
Bear in Jackson and Josephine Counties	Nov. 1–Nov. 30.
In rest of district 1	No close season.
Silver-gray squirrel (see exception)	Sept. 15–Oct. 20.
Exception: In Benton, Clackamas, Douglas, Josephine, Lane, Linn, Marion, Multnomah, Polk, Washington, and Yamhill Counties	No close season.
Mountain or plumed and California or valley quail in Coos, Curry, Douglas, Jackson, Josephine, and Yamhill Counties only	Oct. 15–Oct. 31.
Blue or sooty grouse, ruffed grouse or native pheasant, Chinese pheasant (see exception)	Oct. 15–Oct. 31.
Exception: Chinese pheasant in Clatsop, Curry, Lincoln, and Tillamook Counties	No open season.
Duck, goose, brant, coot, Wilson's snipe or jacksnipe	Oct. 1–Jan. 15.
Rail and gallinule, other than coot	Oct. 1–Nov. 30.
District No. 2,[70] east of Cascades:	
Deer (male, with forked horns)	Sept. 15–Oct. 20.
Bear in Klamath County	Nov. 1–Nov. 30.
In rest of district 2	No close season.
Mountain or plumed and California or valley quail in Crook, Deschutes, Gilliam, Klamath, Lake, Morrow, Sherman, Umatilla, and Wasco Counties only on October 1, and on Wednesdays and Sundays	Oct. 1–Oct. 31.
Blue or sooty grouse, ruffed grouse or native pheasant	Sept. 10–Oct. 20.
Hungarian partridge in Morrow, Sherman, Umatilla, and Wallowa Counties only on Wednesdays and Sundays	Oct. 1–Oct. 31.
Chinese pheasant in Baker, Crook, Deschutes, Gilliam, Grant, Hood River, Klamath, Malheur, Morrow, Umatilla, Union, Wallowa, and Wasco Counties only on October 1, and Wednesdays and Sundays	Oct. 1–Oct. 31.
Duck, goose,[71] brant, coot, Wilson's snipe or jacksnipe	Oct. 1–Jan. 15.
Rail and gallinule, other than coot	Oct. 1–Nov. 30.

No open season: Doe and spotted fawns, moose, elk, antelope, mountain sheep, mountain goats, Franklin's grouse, fool hens, wild turkeys, quail, and introduced pheasants (except as above), bobwhite quail, sage hens, prairie chickens, doves; band-tailed pigeons, swans, wood duck, auklets, auks, bitterns, little brown and sand-hill cranes, fulmars, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, terns, and all shore birds (except Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, $15, angling, $3. Alien: Gun license, $25 (in addition to hunting and angling license). Resident, game and fish, $5; game, $3; angling, $3; hunting $1.50, angling, $1.50, issued to residents between 14 and 18 years of age and authorizes hunting or angling in county of residence and adjoining counties. License issued by county clerks and duly appointed agents throughout the State. Guide, $3 (issued only to citizens of United States); taxidermist, $5; issued by commission. Licenses not issued to persons under 14. Owner and member of his family may hunt, trap, or fish on own premises without license during open season. Licenses, good for life, issued free of charge by State game commission to pioneers of State who arrived prior to 1870, veterans of Indian and Civil Wars, residents of State Soldiers' Home and disabled veterans of World War. Unlawful to hunt on inclosed or occupied land of another without permission of owner. Unlawful to shoot from highway or railroad right of ways, or within cemeteries or incorporated towns.

Bag limits and possession: Two deer a season; 5 silver-gray squirrels in 7 consecutive days; 10 quail in 7 consecutive days in district 1; 4 quail a day, 8 in 7 consecutive days in district 2; 4 in all of ruffed grouse, pheasants, sooty or blue grouse and west of Cascades Chinese pheasants a day, 8 in 7 consecutive days, but a bag of 8 shall not include more than 1 Chinese pheasant hen, but east of Cascades Chinese pheasants have a separate limit of 4 a day, 8 in 7 consecutive days, but not more than 1 hen may be taken in 7 consecutive days; 4 Hungarian partridges a day, 8 in 7 consecutive days, 15 in all of ducks, Wilson's snipe, rails, coots, and gallinules a day, 20 in 7 consecutive days; 8 geese a day, 30 in 7 consecutive days. Migratory game birds properly tagged may be possessed during first 10 days of close season; other game, when properly tagged, during close season.

Interstate transportation: Export of all protected game prohibited, except when tagged with metal seal and accompanied by permit from State warden showing kind of game and names and addresses of consignor and consignee.

Game taken outside of State and legally exported may be imported and possessed as authorized by permit and tag (fee, 5 cents) obtained from State game warden, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season.

Sale: Sale of all protected game prohibited. Commission may make regulations permitting sale of game except migratory birds.

PENNSYLVANIA

Open seasons:[72]	*Dates inclusive*
Deer (male, with 2 or more points to 1 antler), bull elk (with 4 or more points to 1 antler)	Dec. 1–Dec. 15.[73]
Bear (over 1 year old)	Nov. 1–Dec. 15.[72] [73]
Raccoon	Nov. 1–Jan. 15.
Hare, rabbit, squirrel (black, gray, fox), quail	Nov. 1–Nov. 30.
Red or pine squirrel	Nov. 1–Aug. 15.
Male ring-necked pheasant, wild turkey (see exception)	Nov. 1–Nov. 15.
Exception: Wild turkey in Fayette, Somerset, and Westmoreland Counties (1931).	
Blackbird	Aug. 1–Nov. 30.
Woodcock, Wilson's snipe	Oct. 15–Nov. 14.
Duck, goose, brant, coot	Oct. 1–Jan. 15.

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[69] *Oregon:* Commission may open or close season on any species of game birds in any county or district for such time as it may designate and governor may suspend season on account of fire hazard in forest area.

[70] District No. 1, west of Cascades, includes Benton, Clackamas, Clatsop, Columbia, Coos, Curry, Douglas, Jackson, Josephine, Lane, Lincoln, Linn, Marion, Multnomah, Polk, Tillamook, Washington, and Yamhill Counties. District No. 2, east of Cascades, includes all other counties in State.

[71] Unlawful to kill geese or other wild bird or animal at any time on islands or sand bars or within one-fourth mile of high-water line on Columbia east of eastern entrance of Celilo Canal or on islands and sand bars in Deschutes and John Day Rivers from Columbia River to point half a mile south of Oregon Trail highway bridges where the highway crosses said rivers, respectively.

[72] *Pennsylvania*: Seasons may be extended, closed, or shortened and bag limits reduced by commission.

[73] In killing deer, elk, or bears, only one all-lead, lead-alloy, soft-nosed, or expanding bullet may be used at each discharge. The use of steel-jacketed bullets is prohibited. Bow and arrow may be used.

Open seasons—Continued.	*Dates inclusive*
Rail, other than coot and gallinule	Sept. 1–Nov. 30.
Gallinule	Oct. 1–Nov. 30.

No open season: Cow elk and calves having less than 4 points to one antler; does, fawns, bear cubs under 1 year of age; ruffed grouse, Hungarian partridges or quail; pheasant hens, doves, swans, wood duck, eider ducks, reedbirds, auks, bitterns, little brown and sand-hill cranes, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting and fishing licenses: *Game:* Nonresident, $15. Issued by county treasurer. Resident, $2. Licenses not issued to minors under 14, and minors between 14 and 16 must furnish written consent of parent or guardian. Licensee required to wear tag displayed on middle of back.

Resident citizen and members of family or employees residing upon and cultivating land in State as either owner or lessee may hunt during open season on such land and with consent of owner, on adjoining land without a license. Taxidermist license, fee $1.

Licensed hunters, within 30 days after expiration of license, must report amount of game killed.

Aliens not permitted to hunt or be possessed of dogs or firearms.

Fishing: Nonresident pays same fee charged nonresident by State where applicant resides, but not less than $2.50 (10 cents extra to county treasurer); issued by county treasurer or department of revenue.

Resident, $1.50 (10 cents extra to county treasurer); issued by county treasurer or department of revenue. License not required of minors under 16. Persons and members of family who reside upon their own farms or other lands throughout the entire year may angle in waters on or adjacent thereto during open season without license.

Bag limits and possession: One deer (6 to party camping or hunting together); 1 elk (1 to hunting party), 1 bear (4 to hunting party), 1 wild turkey, 30 rabbits, 15 hares, 20 squirrels, 25 quail (combined), 6 male ring-necked pheasants, 20 woodcock, 60 ducks, 30 geese and brant a season. Five rabbits, 3 hares, 6 squirrels (black, gray, fox), 8 quail (combined), 2 male ring-necked pheasants, 4 woodcock, 15 ducks, 5 geese and brant, 20 Wilson's snipe, 25 coots, 25 sora, 25 in all of other rails and gallinules but not more than 15 of any one species of rails (except sora) and gallinules, a day. Possession of migratory birds permitted during first 10 days of close season; other game during first 30 days thereof.

Interstate transportation: Export of all protected game taken in State prohibited; provided, a nonresident licensee may take out with him on same conveyance 2 days' limit of game except elk. Small game must be accompanied by owner and if concealed must be tagged to show name and address of owner, county where killed, and number of each species in package. Large game may be shipped by express when plainly marked to show name and address of owner and county in which killed. Specimens and trophies of game legally taken may be shipped by parcel post or otherwise to a licensed taxidermist for mounting, if marked to show contents, but no such shipments may be made to points outside the State without a permit. Skins of bears or raccoons may be shipped out of State by parcel post or otherwise if package is marked to show contents.

Game taken outside of State and legally exported may be possessed at any time, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season.

Sale: Sale prohibited of wild deer and rabbits taken in the State, and of all other game wherever taken. Trophies of game not killed in State and skins of bears and raccoons wherever taken may be purchased or sold at any time.

Miscellaneous: Automatic gun prohibited.

RHODE ISLAND

Open seasons:	*Dates inclusive*
Gray squirrel (see exception) hare, rabbit	Nov. 1–Dec. 31.
Exception: Gray squirrel on Conanicut Island	No open season.
Quail or bobwhite, ruffed grouse or partridge, cock pheasant (see exceptions)	Nov. 1–Dec. 31.
Exceptions: Cock pheasants in town of New Shoreham (4 days only), Oct. 16, Nov. 6 and 20 and Dec. 4, and in town of Jamestown (2 days only), Nov. 4 and 11.	
Duck, goose, brant, coot	Oct. 1–Jan. 15.
Wilson's snipe	Oct. 1–Nov. 30.
Woodcock	Nov. 1–Nov. 19.
Rail and gallinule, other than coot	Sept. 1–Nov. 30.

No open season: Deer[74] doves, Hungarian partridges, hen pheasants, swans, wood duck, eider ducks, auks, bitterns, little brown and sand-hill cranes, gannets, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, shearwaters, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, $10.25; fish, $2.50.[75] Alien: Game,$ 15.25; fish, $2.50, alien resident for 1 year; $5, alien, not resident for 1 year. Resident: Game, $2.25; fish, $1.25. Issued by city and town clerks. Fishing license not required of women, nor of males under 18. License not required of resident or his immediate family to hunt on own or leased agricultural lands on which actually domiciled; nonresident owning real estate valued at not less than $500, and nonresident member or guest of club incorporated for hunting or fishing purposes prior to Jan. 1, 1909, which owns real estate assessed for taxation at value of not less than $1,000, may procure license at a fee of $2.25; licenses not issued to minors under 15. Consent of owner required for hunting upland game birds on land of another from January 1 to October 31.

Bag limits and possession: Two ruffed grouse or partridges, 3 cock pheasants, 6 quail, 15 ducks, 8 geese, 8 brant, 4 woodcock (except 2 a day in towns of New Shoreham and Jamestown); 15 Wilson's snipe, 15 coots, 15 rails, 25 in all or rails and gallinules a day, but not more than 15 of any one species of gallinules, and not more than 15 game birds of all kinds (other than waterfowl, coots, and gallinules) in possession at one time. Possession of waterfowl, coots, and gallinules permitted during first 10 days of close season.

Interstate transportation: Export of all game prohibited; privided, a nonresident licensee may take out under his license 10 wild fowl or birds in one calendar year, if carried open to view.

Game taken outside of State and legally exported may be imported and possessed as authorized by permit from commissioners of birds, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season.

Sale: Sale of all game birds prohibited.

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[74] *Rhode Island:* Deer injuring crops may be killed at any time by owner or occupant of premises under written permit from secretary of State. Any person killing or wounding a deer must report within 48 hours to commissioners of birds.

[75] Fee required of nonresident angler equal to that required of nonresident in his State of residence.

SOUTH CAROLINA

Open seasons:[76]	*Dates inclusive*
Deer (male) (see exception)	Aug. 15–Jan. 1.
Exception: In Greenville, Oconee, and Pickens Counties, 1 day only	Jan. 1, 1930.
Rabbit,[77] squirrel,[77] quail (partridge), wild turkey, black bird (see exceptions)	Nov. 28–Mar. 1.[78]
Exceptions: Squirrel, quail (partridge), wild turkey, in Cherokee County	Nov. 28–Feb. 1.
Quail (partridge), wild turkey, in Chester County	Nov. 28–Jan. 15.
Quail (partridge), in Darlington County	Dec. 24–Mar. 1.
In Fairfield County	Nov. 28–Feb. 15.
In Greenville County	Nov. 28–Nov. 29. Dec. 24–Mar. 1.
Wild turkey, in Greenville County, 1 day only	Jan. 1. 1930.
Squirrel, in Oconee and York Counties	Nov. 1–Mar. 1.
Raccoon, opossum	Sept. 1–Mar. 1.
Woodcock	Dec. 1–Dec. 31.
Dove	Sept. 1–Sept. 30. Nov. 20–Jan. 31.
Duck, goose, brant, coot, Wilson's snipe	Nov. 1–Jan. 31.
Rail and gallinule, other than coot	Sept. 1–Nov. 30.

No open season: Doves, ruffed grouse (pheasants), swans, wood duck, reedbirds, auks, bitterns, little brown, sand-hill, and whooping cranes, gannets, grebes, gulls, herons, jaegers, loons, murres, petrels, shearwaters, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, $15.25; fish, $3.25. Issued by county game warden. Resident: Game, State, $3.10; county of residence, $1.10. Issued by county game warden and his agents.

No license required of resident owners, tenants, their children, or, under written permission, their employees, to hunt during open season on own lands. Confederate veteran wearing his cross of honor may hunt and fish in any county of State without license.

Consent of owner or manager required to hunt on land of another.

Hunting clubs and game preserves must register with chief game warden of State, file list of members including names and addresses, and during March of each year report number and kind of game killed by members during season.

Bag limits and possession: Five deer, 20 wild turkeys a season; 15 squirrels, 15 quail (partridges), 2 turkeys, 25 doves, 25 ducks, 8 geese, 8 brant, 4 woodcock, 20 Wilson's snipe, 25 coots, 25 sora, and 25 in all of other rails and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules a day. Possession of migratory birds permitted during first 10 days of close season.

Interstate transportation: Export of all resident nonmigratory game taken in State prohibited, except that a land owner or licensee may export under shipping tag from chief game warden of State 1 day's bag limit of resident nonmigratory game a week, if not for sale. Unlawful for any transportation company to receive for shipment out of the State any deer or other resident nonmigratory game unless duly tagged. Under Federal regulations not more than two days' limit of migratory birds may be taken or shipped out of the State in any one calendar week. All packages containing migratory birds must be marked to show actual contents and names and addresses of consignor and consignee. No game may be removed from the State for sale.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale prohibited of deer, quail (partridges), doves, wild turkeys, reedbirds, and all other migratory birds.

SOUTH DAKOTA

Open seasons:	*Dates inclusive*
Deer (male with visible horns), in Meade, Lawrence, Pennington, Custer, and Fall River Counties only	Nov. 1–Nov. 20.
Duck, goose, brant, coot, Wilson's snipe	Sept. 16–Dec. 31.
Rails and gallinule, other than coot	Sept. 16–Nov. 30.

No open season: Deer, except as above, elk, antelope, mountain sheep, quail, Hungarian partridges, doves, partridges or ruffed grouse, prairie chickens or pinnated grouse, white-breasted or sharp-tailed grouse, sage grouse, introduced pheasants,[79] upland plover, woodcock, swans, wood duck, eider ducks, bitterns, little brown, sand-hill, and whooping cranes, grebes, gulls, heron, loons, shearwaters, terns, and all shore birds (except Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident or alien: Big game, $25; small game, $25; fish, $2. Issued by game warden or county treasurer. Resident: Big game, $5; small game and fish, $1; issued by county treasurer, game and fish commission, and deputies; special license, small game, $3 (hunting; also authorizes shipment of 50 birds in the State as specified in license); issued by game and fish commission. Fishing license not required of resident women, or of resident males under 18. Hunting and fishing license not issued to persons under 15 unless applied for by parent or guardian. Hunting game birds during open season on own land permitted without license. Unlawful to hunt on land of another without permission of owner or lessee. Taxidermist, $2.

Bags limits and possession: One deer a year; 15 ducks, geese, brant, Wilson's snipe, coots, gallinules, sora, and other rails in the aggregate of all kinds a day, 30 in all in possession (but not more than 5 geese and brant a day, 10 in possession). Possession permitted during open season and five days thereafter.

Interstate transportation: Export of all protected game prohibited; provided, a nonresident may export 1 deer lawfully killed under permit of game and fish commission and not more than 5 upland nonmigratory birds under each of 5 of the coupons, and not more than 5 migratory game birds under each of 5 of the coupons attached to his nonresident license; but not more than 16 geese and 16 brant may be exported by one person in any one calendar week, and if exported by common carrier or as personal baggage tags attached to hunting license must be affixed to each shipment.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale of all protected game prohibited; provided skins, heads, and antlers of deer lawfully killed may be sold.

TENNESSEE

Open seasons:	*Dates inclusive*
Deer, male, with horns having 2 or more spikes each (see exception)	Dec. 20–Dec. 31.
Exception: In Carter, Johnson, Sullivan, and Unicoi Counties	No open season.

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[76] *South Carolina:* Chief game warden of State may close seasons for periods not exceeding 10 days at one time on any waters or swamps of State when necessary to protect deer or other game on account of floods or other abnormal conditions; and on recommendation of any county legislative delegation may shorten season on any kind of game.

[77] Between Sept. 1 and Thanksgiving Day rabbits may be hunted without firearms, and squirrels may be hunted without dogs, except in Oconee and York Counties, where squirrels may be hunted without dogs only from Nov. 1 to Thanksgiving Day.

[78] Season opens on Thanksgiving Day.

[79] *South Dakota:* Chinese, ring-necked, or English pheasants, partridges or ruffed grouse, prairie chickens or pinnated grouse, white-breasted or sharp-tailed grouse, and sage grouse may be taken and shipped under regulations of game and fish commission, Pierre.

Open seasons—Continued.	*Dates inclusive*
Squirrel (see exceptions)	June 1–Jan. 1.
Exceptions: In Carter, Greene, Unicoi, and Washington Counties	Aug. 1–Jan. 1.
In Decatur County (also May 1–Aug. 1)	Oct. 1–Feb. 1.
In Cannon and Wilson Counties	No close season.
Rabbit (see exceptions)	No close season.
Exceptions: In Carter County	Nov. 15–Jan. 15.
In Davidson, Hamilton, Hardin, Hawkins, Jefferson, Johnson, Lawrence, and Sullivan Counties	Nov. 15–Feb. 15.
In Crockett County	Nov. 25–Feb. 1.
In Hardeman County	Oct. 25–Mar. 1.
In Madison County	Nov. 24–Feb. 1.
In Williamson County	Nov. 1–Feb. 1.
Quail or partridge (see exceptions)	Nov. 25–Feb. 1.
Exceptions: In Carter County	Nov. 15–Jan. 15.
In Decatur County	Dec. 10–Feb. 20.
In Fayette County	Dec. 10–Feb. 15.
In Lauderdale and Hardin Counties	Dec. 10–Mar. 1.
In Hardeman and Madison Counties	Nov. 24–Feb. 1.
In Haywood County	Dec. 10–Feb. 14.
In Sullivan County	Nov. 25–Jan. 1.
In Washington County	Nov. 25–Jan. 15.
In Claiborne and Monroe Counties	No open season.
Pheasant, in Carter, Greene, Unicoi, and Washington Counties only	Nov. 20–Dec. 20.
Wild turkey, in Lauderdale County only	Nov. 1–Jan. 25.
Duck, goose, brant, coot, mudhen, Wilson's snipe or jacksnipe	Nov. 1–Jan. 31.
Dove (see exceptions)	Sept. 1–Dec. 15.
Exceptions: In Carter County	Nov. 15–Dec. 15.
In Claiborne County	No open season.
Rail, other than coot and gallinule	Sept. 1–Nov. 30.
Gallinule	Nov. 1–Nov. 30.

No open season: Does and fawns; wild turkeys, in Carter, Greene, Unicoi, and Washington Counties (1931); grouse, ring-necked and Mongolian pheasants, woodcock, swans, wood duck, bitterns, sand-hill and whooping cranes, grebes, gulls, herons, loons, terns, and all shore birds (except Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, $15 (may hunt on own land without license); fish, $2.50. Resident, State, $2 (resident must hold State license to hunt on Reelfoot Lake); county, $1 (county licensee may obtain State license for $1). Issued by county clerks. Licensee required to wear license tag displayed in center of back of outer garment.

Owners and tenants may hunt without license on land on which they reside. Unlawful to hunt on tillable or inclosed lands of another without permission.

Reelfoot Lake.—Guide or pusher, $1 (issued to residents only.)

Bag limits and possession: Two deer a season; 15 quail, 20 other game birds or animals a day, but not more than 8 geese, 8 brant, 15 of any one species of rails (other than sora) and gallinules a day.

Local limits.—In Lauderdale County, 2 wild turkeys, 6 squirrels, 12 quail a day or in possession.

Reelfoot Lake.—Twenty ducks, 8 geese, 8 brant, 20 Wilson's snipe, 20 in all of rails, coots, and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules, but not more than 20 in all of game birds a day.

Interstate transportation: Export of all protected game prohibited; provided, nonresident licensee may take out of State, if carried openly, game birds legally killed by him (except that 25 birds only may be exported from Reelfoot Lake), but not more than 50 ducks, 16 geese, 16 brant, 40 Wilson's snipe, 50 coots, 50 sora, 50 in all of rails and gallinules, but not more than 30 of any one species of rails (other than sora) and gallinules, and 50 doves may be exported by one person in any one calendar week.

No restrictions on export of rabbits except in counties where protected.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale of all protected game (except rabbits) killed in State prohibited.

TEXAS

Open seasons:	*Dates inclusive*
Deer (male, with pronged horn) (see exceptions), bear	Nov. 16–Dec. 31.
Exceptions: Black-tailed deer (male, with pronged horn), west of Pecos River	Nov. 16–Nov. 30.
Deer, in Bastrop, Hamp hill, Hutchinson, Parker, Palo Pinto, and Roberts Counties	No open season.
Squirrel (see exceptions)	May 1–July 31. Oct. 1–Dec. 31.
Exceptions: In Angelina, Bowie, Cass, Chambers, Cherokee, Hardin, Jasper, Jefferson, Liberty, Marion, Morris, Nacogdoches, Newton, Orange Panola, Rusk, Sabine, San Augustine, San Patricio, Shelby, Smith, and Tyler Counties	Nov. 1–Jan. 31.
In Austin, Bandera, Bastrop, Blanco, Bosque, Brazoria, Brown, Burnet, Caldwell, Callahan, Colorodo, Comal, Comanche, Cook, Coryell, DeWitt, Dimmitt, Eastland, Edwards, Erath, Fayette, Fort Bend, Gillespie, Goliad, Gonzales, Guadalupe, Hamilton, Hays, Hill, Jackson, Karnes, Kendall, Kerr, Kimble, Lampasas, Lavaca, Llano, Mason, McCulloch, Matagorda, Medina, Menard, Mills, Montague, Real, San Saba, Schleicher, Stephens, Tarant, Throckmorton, Travis, Uvalde, Victoria, Waller, Washington, Wharton, Wilson, Wise, and Zavella Counties	No close season.
Quail or partridge, chachalaca or Mexican pheasant	Dec. 1–Jan. 16.
Prairie chicken or pinnated grouse (see exception)	Sept. 1–Sept. 4.
Exception: In Collingsworth and Wheeler Counties	June 15, 1931.
Wild-turkey gobblers (see exception)	Nov. 16–Dec. 31.
Exception: In Brooks, Cameron, Hidalgo, Kleberg, Nueces, Kenedy, Starr, and Willacy Counties	Nov. 16, 1930.
Mourning dove, in north zone (see exceptions)	Sept. 1–Oct. 31.[80]
Exceptions: In McCulloch, San Saba, Menard, Mason, Kimble, Llano, Kerr, Gillespie, and Blanco Counties	Oct. 1–Nov. 30.

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[80] *Texas:* North and south zones divided by line running approximately from Rio Grande River east through Del Rio, thence following center of main track of Southern Pacific Railroad through Spofford, Uvalde, and Hondo to San Antonio; thence following International & Great Northern Railroad to Austin; thence along Houston & Texas

Open seasons—Continued.	*Dates inclusive*
In Cook, Grayson, Fannin, Lamar, Denton, Collin, Rockwall, and Kaufman Counties	Sept. 15–Nov. 1.
In Red River, Bowie, Delta, Hopkins, Franklin, Titus, Camp, Morris, Cass, Wood, Upshur, Marion, Harrison, Gregg, Smith, Van Zandt, Henderson, Rusk, Panola, Freestone, Anderson, Cherokee, Robertson, Leon, Houston, Burleson, Madison, Walker, Trinity, Erath, Hood, Hamilton, Coryell, and parts of Nacogdoches, Shelby, Angelina, Polk, San Jacinto, Liberty, Montgomery, Grimes, Brazos, Washington, Fayette, Lee, and Bastrop Counties	Dec. 1–Dec. 15.
In south zone (see exceptions)	Nov. 1–Nov. 30.[80]
Exceptions: In Calhoun, Goliad, Victoria, DeWitt, Lavaca, Fort Bend, Austin, Waller, Chambers, Jefferson, Orange, Hardin, Tyler, Jasper, Newton, Sabine, San Augustine, and parts of Shelby, Nacogdoches, Angelina, Polk, San Jacinto, Liberty, Montgomery, Grimes, Brazos, Washington, Fayette, Lee, and Bastrop Counties	Dec. 1–Dec. 31.
White-winged dove	Aug. 8–Oct. 31.
Duck, goose, brant, Wilson's snipe or jacksnipe, coot, in north zone	Oct. 16–Jan. 31.[80]
In south zone	Nov. 1–Jan. 31.[80]
Rail, other than coot and gallinule	Sept. 1–Oct. 31.
Gallinule, in north zone	Oct. 16–Nov. 30.
In south zone	Nov. 1–Nov. 30.

No open season: Does, fawns, spike bucks, antelope, mountain sheep, turkey hens, robins, pheasants (except chachalacas), woodcock, swans, wood duck, bitterns, little brown, sand-hill, and whooping cranes, gannets, grebes, gulls, herons, jaegers, loons, petrels, band-tailed pigeons, terns, and all shore birds (except Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident or alien: Game, $25; fish (artificial lure), $5; nonresident, 5-day license, $1.10. Resident citizen: Game, $2; not required in county of residence; fish (artificial lure), $1.10; issued by commissioner, deputies, and county clerks. Boat (carrying hunters), $2; club or shooting preserve, $5. Issued by commissioner. Manager of club or shooting preserve must keep record, require guests to register number of game killed, and make complete report to commissioner by Feb. 10 of each year. Hunting license not required of persons under 17. License does not entitle holder to hunt on inclosed and posted lands of another without consent of owner or agent.

Bag limits and possession: Two deer, 1 bear, 3 turkey gobblers a season; 10 squirrels a day; 12 in all of quail and chachalacas a day, 36 in 7 days, 36 of each in possession; in Wood County, 8 a day, 24 in 7 days; 10 prairie chickens a day or season; 15 doves and white wings a day, 45 in 7 days or in possession; in Wood County, 10 a day, 30 in 7 days; 25 in all of ducks, rails, coots, gallinules, and Wilson's snipe a day, but not more than 20 Wilson snipe, or 15 of any one species of rails (other than sora) and gallinules a day, 50 in all in 7 days; 4 geese and brant a day, 12 in 7 days, but not more than 25 in all of waterfowl, rails, coots, gallinules, and shore birds a day, and not more than 50 game birds of all kinds in 7 days or in possession. Possession of all game permitted during open season and 10 days thereafter.

Interstate transportation: Export prohibited of all game, except that nonresident licensee may ship game lawfully possessed to his home for own use under affidavit (fee, 25 cents) that it was lawfully killed and will not be bartered or sold; provided that not more than two days' limit of migratory birds may be exported in any one calendar week. Game may be shipped to taxidermist for mounting under affidavit that shipper killed the specimen and that it is not being preserved for sale.

Game taken outside the State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale prohibited of all protected game.

UTAH

Open seasons: [81]	*Dates inclusive*
Deer (buck, with horns not less than 5 inches long) [82]	Oct. 20–Oct. 30.
Bear, rabbit, hare	No close season.
Duck, goose, brant, coot, Wilson's snipe or jacksnipe (see exceptions)	Oct. 1–Dec. 31.
Exceptions: In Beaver, Emery, Grand, Iron, Kane, Millard, Morgan, Rich, San Juan, Sevier, Summit, Uintah, Wasatch, and Washington Counties	Oct. 1–Jan. 15.
Duck, in Fish Lake Game Preserve	Oct. 1–Nov. 30.
Gallinule	Oct. 1–Nov. 30.

No open season: Does, fawns, elk,[83] antelope, mountain sheep, mountain goats, quail, any species of grouse or sage hens, Hungarian partridges, mourning doves,[84] swans, wood duck, rail, bitterns, sand-bill cranes, grebes, gulls, herons, loons, band-tailed pigeons, terns, and all shore birds (except Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident citizen: Small game and fish, $10; deer and bear, $15; fish, $3. Resident citizen (male): Game and fish, 12 to 16 years, $1; 16 and over, $3; game, $2; fish, $2; females, 16 and over, game and fish, $1; guide, $5. Alien: Fish, $7.50. Persons under 16 not permitted to kill deer. Aliens prohibited from hunting in State. Resident citizens, males under 12, and females under 16, not required to obtain licenses to fish. Issued by State fish and game commissioner or deputy, county clerk, or deputy or authorized agent.

Bag limits and possession: One buck a season; 25 ducks, geese, brant, Wilson's snipe, coots, and gallinules a day, but not including more than 8 geese or brant; 15 Wilson's snipe or more than 15 of any one species of gallinules a day. Not more than 25 game birds in all may be taken in one day; 50 in all of game birds in possession at any one time.

Interstate transportation: Export of all game prohibited, except under permit and regulations of commissioner.

Game taken outside of State and legally exported may be possessed at any time, except that migra-

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Central Railroad through Elgin, Giddings, and Brenham to Brazos River; thence with center of Brazos River to Beaumont branch of Santa Fe Railway; thence following Gulf, Colorado & Santa Fe Railroad through Navasota, Montgomery, and Conroe to Cleveland; thence along Houston, East & West Texas Railroad to point where it strikes Louisiana line. For detailed boundary line see Service and Regulatory Announcements—B. S, No. 71 obtainable from Department of Agriculture, Washington, D. C., or State game law to be had from game, fish, and oyster commissioner, Austin, Tex.

[81] *Utah:* Commissioner may shorten or close open season and reduce bag limit on any species of game birds or animals needing additional protection.

[82] Person under 16 may not hunt deer.

[83] Elk doing damage may be killed under authority of commissioner.

[84] Commissioner, upon determining that quail, any species of grouse or sage hens, Hungarian partridges, or mourning doves have increased sufficiently, may prescribe an open season and fix bag limits on any such birds.

tory game birds may be possessed only during open season where taken and first 10 days of close season. Persons possessing game during close season in State must show lawful taking.

Sale: Sale of all game prohibited; except that rabbits, bears, and hides of deer legally killed may be sold.

VERMONT

Open seasons:	*Dates inclusive*
Deer (with horns not less than 3 inches long)[85] (see exception)	Nov. 10–Nov. 20.
Exception: In Franklin County	Jan. 1, 1932.
Hare, rabbit	Oct. 1–Feb. 28.
Gray squirrel, woodcock	Oct. 1–Oct. 31.
Quail	Sept. 15–Nov. 30.
Duck (see exception) goose, brant, coot	Sept. 16–Dec. 31.
Exception: Ducks on waters or shores of Joes Pond in towns of Danville, Cabot, and Walden, Stone Pond or Shadow Lake in town of Glover, Caspian Lake in town of Greensboro, and Groton or Lunds Pond in town of Groton (1937).	
English or Wilson's snipe (jacksnipe), gallinule	Sept. 16–Nov. 30.

No open season: Elk, moose, caribou (1932); does, fawns, doves, rail, pheasants, European partridges (1932); ruffed grouse or partridges (1931); swans, wood duck, auks, bitterns, sandhill and whooping cranes, grebes, gulls, herons, jaegers, loons, murres, petrels, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game and fish, $10.50; fish, $3.15, but residents of States or countries charging larger nonresident angling license fee must pay fee charged nonresidents in own State or country. Resident: Game and fish, $1.50; game, $1; fish, $1. Issued by town clerks. Citizen of United States who owns $1,000 taxable property in Vermont pays same fees as resident. Alien resident who has not declared his intention, pays same fees as nonresident; declarant resident for six months in State pays same fees as resident.

Hunting licenses not issued to persons under 16 without written consent of parent or guardian. Owners of farm lands and their resident minor children or tenants may hunt without a license on own lands during open season. Fishing license not required of persons under 15.

Bag limits and possession: One deer a season; 4 woodcock a day, 25 each a season; 5 hares or rabbits a day or in possession; 4 gray squirrels, 4 quail, 12 ducks a day, 50 a season, 5 geese a season; 8 brant; 10 Wilson's snipe a day; 25 coots, 25 gallinules but not more than 15 gallinules of any one species a day.

Possession of waterfowl, coots, and gallinules permitted during first 10 days of close season.

Interstate transportation: Export prohibited of all protected game, except hares and rabbits; provided, a nonresident licensee may export one deer under license coupon and one day's bag limit of game birds under permit, but must accompany shipment; resident may export (if not for sale) one day's bag limit of game birds under special permit from commissioner and one deer a season for sale, if it is tagged and license is presented to carrier for cancellation, but laws of State to which deer is shipped must be complied with. Packages containing game delivered to a common carrier for transportation must be tagged to show number and kind of such game therein, names of consignor and consignee, station from which shipped, destination, and number of license. License of shipper must be presented to agent of transportation company for indorsement thereon of quantity of game offered for transportation. Head, hides, feet, and fur of quadrupeds and plumage and skins of game birds legally killed and possessed may be transported without tags if accompanied by owner.

Game taken outside of State and legally exported may be possessed as authorized by permit obtained from fish and game commissioner, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season.

Sale: Sale of squirrels and all protected game birds prohibited; deer may be sold during open season and for a "reasonable time thereafter," and hares and rabbits during open season. Head and hide of deer legally taken may be sold.

VIRGINIA

Open seasons:[86]	*Dates inclusive*
Deer (male, with horns visible above the hair):	
East of the Blue Ridge Mountains (see exceptions)	Nov. 15–Dec. 31.
Exceptions: In Nansemond County	Oct. 1–Nov. 30.
In King George, Lancaster, Northumberland, Richmond, Stafford, and Westmoreland Counties	No open season.
West of the Blue Ridge Mountains (see exceptions)	Nov. 15–Dec. 1.
Exceptions: In Bath County	Nov. 15–Nov. 20.
In Augusta, Bland, Frederick, Grayson, Highland, Montgomery, Roanoke, Rockingham, Russell, Shenandoah, Smyth, Tazewell, Washington, and Wythe Counties	No open season.
Elk (see exceptions)	Dec. 15–Dec.31.[87]
Exceptions: Bull elk only, with horns plainly visible above the hair, in Bland, Craig, Giles, Montgomery, and Pulaski Counties (1929)	Nov. 15, 16, 18.[87]
In national-forest areas	No open season.
Bear, raccoon, opossum	Oct. 1–Jan. 31.
Squirrels (see exceptions)	Sept. 1–Jan. 31.[88]
Exceptions: West of the Blue Ridge Mountains, and in Culpeper, Fairfax, Fauquier, Greene, Loudoun, Orange, Prince William Rappahannock, and Stafford Counties	Sept. 1–Dec. 31.[88]
In Bath County	Nov.15–Nov.30.[88]
In Buchanan County	Sept.15–Dec.31.[88]
In Chesterfield and Spotsylvania Counties	Nov. 15–Jan.31.[88]
In Frederick County	Sept. 1–Oct. 14.[88] Nov. 16–Jan. 31.[88]
In James City County	Nov. 15–Jan. 31.[88]
Hare (rabbit),[88] wild turkey, quail (partridge) (see exceptions	Nov. 15–Jan. 31.
Exceptions: West of the Blue Ridge Mountains, and in Culpeper, Fairfax, Fauquier, Greene, Loudoun, Orange, Prince William, Rappahannock, and Stafford Counties	Nov. 15–Dec. 31.

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[85] *Vermont:* Landowner, member of his family, or authorized employee may kill deer doing damage to his fruit trees or crops; but person under whose direction a deer is so killed must, within 12 hours, report the matter in a signed statement to nearest fish and game warden. Deer may also be killed at any time in orchard zones established by commissioner, but such killing must forthwith be reported to owner of orchard and county warden.

[86] *Virginia:* Commission of game and inland fisheries may by regulation further restrict the time, manner, and means by which game may be taken.

[87] Elk doing damage to private property may be killed at any time under permit of commission of game and inland fisheries.

[88] Residents of State may kill rabbits or hares and squirrels on their own lands at any time.

Open seasons—Continued.	*Dates inclusive*
Wild turkey, in Spotsylvania County	Nov. 15–Dec. 31.
In Albemarle, Franklin, Giles, Henry, James City (1930), Lee, Lancaster, Northumberland, Pulaski, Richmond, Roanoke, Russell, Scott, Smyth, Tazewell, Washington, Westmoreland, and Wise Counties	No open season.
Rabbit, wild turkey, in Bath County	Nov. 15–Nov. 30.
Quail, in Bath County	Nov. 15–Dec. 15.
In Dinwiddie County	Nov. 15–Jan. 15.
Ring-necked pheasants, in Bath, Clarke, Frederick, New Kent, and Shenandoah Counties	No open season.
Grouse (pheasant) (see exceptions)	Nov. 15–Jan. 31.
Exceptions: West of the Blue Ridge Mountains (except in Bath County, Nov. 15–Nov. 30)	Nov. 15–Dec. 31.
In Culpeper, Fairfax, Fauquier, Greene, Loudoun, Orange, Prince William, Rappahannock, and Stafford Counties	No open season.
Dove	Sept. 1–Dec. 15.
Woodcock	Nov. 15–Dec. 15.
Duck, goose, brant, Wilson's or jack snipe, coot, mud hen	Nov. 1–Jan. 31.[89]
Rail and gallinule, other than coot	Sept. 1–Nov. 30.

No open season: Does, fawns, Hungarian partridges, swans, wood duck, eider ducks, reedbirds, auks, bitterns, sand-hill cranes, fulmars, gannets, grebes, gulls, herons, loons, murres, petrels, shearwaters, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting, trapping, and fishing licenses (combined): Nonresident: $15.50 (additional county certificates, fee $10 each, required for bull elk in Bland, Craig, Giles, Montgomery, and Pulaski Counties); angling, $2.50 [90] (not required in tidal waters). Commissioned or enlisted members of Army, Navy, or Marines stationed or located in Virginia pay same fees as residents for hunting licenses. Alien: Game, $15.50 (alien owner of real estate resident for five years, same as resident). Resident: State, $3; county, $1; (county license may be exchanged by holder for State license on payment of $2.20, which includes clerk fee of 10 cents). Issued by clerks of circuit and corporation courts. Licensee required to wear license button. Certificate in lieu of lost or destroyed license issued under affidavit and on payment of clerk fee of 10 cents on county license and 20 cents on other licenses.

Residents, nonresidents, and aliens and their husbands, wives, or children may hunt, trap, or fish on own premises during open season without license; tenant, renter, or lessee, under written consent of owner or landlord, may hunt, trap, or fish during open season without license on premises on which he resides.

Fishing license not required in tidewater section nor of any person under 16.

Written consent required to hunt or trap on lands of another. Does not apply to persons hunting foxes or deer with hounds or dogs, where the chase begins on other lands, nor on uninclosed mountain lands west of the Blue Ridge not used for cultivation, except in Bath, Bland, Giles, and Highland Counties.

Special licenses, Back Bay, Princess Anne County: Battery, sinkbox, mat blind,[91] fee $100 (limited to not more than 50 batteries and sinkboxes and 27 mat blinds actually used in 1927–28. Any license not renewed each year may not be reissued until number of batteries and sinkboxes is less than 25 and that of mat blinds less than 11). Shore blind, $50. Issued by clerk, circuit court, Princess Anne County.

Bag limits and possession: One elk a season; 1 deer a day, 2 a season, except in Bath County, 1 a season; 10 each of squirrels and hares (rabbits) a day, 150 of each a season; 2 turkeys a day, 4 a season; 4 grouse or pheasants a day, 20 a season; 15 quail a day, 150 a season; 25 doves a day, 250 a season; 4 woodcock a day, 25 a season; 25 ducks a day, 350 a season; 8 geese a day, 50 a season; 8 brant a day, 30 a season, but not more than 35 in all of ducks, geese, and brant a day on Back Bay, Princess Anne County; 20 Wilson's snipe a day, 250 a season; 25 sora a day, 500 a season; 25 coots a day, 250 a season; 25 in all of rails (other than sora) and gallinules but not more than 15 of any one species a day, 250 a season. Possession of migratory game birds permitted during open season and 10 days thereafter, and of other game during open season and 5 days thereafter.

Interstate transportation: Export of all protected game (except rabbits and squirrels) prohibited; provided, during open season any licensee may, under his hunting license, take with him out of State, or as baggage on same conveyance, 1 deer, 50 quail or partridges, 10 pheasants or grouse, 3 wild turkeys, 50 waterfowl, but not exceeding 100 in all, if killed or captured by himself, shipped open to view, and plainly labeled with his name and address; but more than 2 days' limit of geese and brant may not be exported by one person in one calendar week. Any citizen of State may ship from State during open season as a gift and not for sale (which fact must be stated on shipping tag), 1 deer, 18 quail or partridges, 6 pheasants, 3 wild turkeys, and 12 waterfowl, if open to view and plainly labeled with names and addressed of donor and donee and number and kind of each so shipped.

Game taken outside of State and legally exported may be possessed in like manner as game taken in State.

Sale: Sale of all game prohibited, except of rabbits and squirrels during open season.

WASHINGTON

Open seasons: [92]	*Dates inclusive*
Deer (male), elk, bear, rabbit, squirrel, and upland game birds, open seasons fixed by county game commissions.[92]	
Duck, goose, brant,[93] coot, Wilson's snipe or jacksnipe:	
East of Cascades	Sept. 16–Dec. 31
West of Cascades	Oct. 1–Jan. 15.
Rail other than coot	Oct. 1–Nov. 30.

No open season: [92] Moose, elk (except as above); does, fawns, antelope, caribou, mountain sheep, mountain goats, and doves; swans, wood duck, eider ducks, auklets, auks, bitterns, little brown and sand-hill cranes, fulmars, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, band-tailed pigeons, puffins, shearwaters, terns, and all shore birds (except Wilson's or jack snipe).

Hunting and fishing licenses: Nonresident citizen or declarant residing in State less than 6 months: State, $25 (applicant from adjoining State pays same fees as charged resident of Washington by State of which he is a resident); game birds, $5; fishing: State, $5; county, $2.50; tourist fishing, State, $3 (valid for 30 days). Resident (includes declarant residing in State six months): State: Game and fish, $7.50; fish, $5; game and fish, county, $1.50; guide, $10; taxidermist, $5. Resident special elk license (fee, $5) (issued to holder of State or county hunting and fishing license): Nonresident, $25 (issued to holder of State hunting and fishing license). Issued by county auditors. Alien: Hunting and fishing, State, $25 (issued only to holder of permit to carry firearms); fishing, county, $5. Professional guide (county), $10. Licensee must report number of game, fish, and fur animals taken previous year before renewal of license. Fishing license not required of residents under 16.

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[89] Wild fowl may not be hunted on Wednesdays, Saturdays, or Sundays, on Back Bay, Princess Anne County.

[90] Residents of States having larger nonresident angling license fee must pay fee charged nonresidents in own State.

[91] Battery, sinkbox, mat blind, or other floating device, or any boat or tender thereof, may not anchor, tie-out, or lie within 700 yards (except in North Bay, 200 yards) of any licensed blind or any blind on shore not licensed that is at any time occupied by the owner, or member or guest of any club owning same, for shooting therefrom.

[92] *Washington:* County game commission, with consent of supervisor of game and game fish, may shorten, close, or open season and fix bag limits on game and fur animals and upland game birds, as designated by statute. Communicate with county game commission at county seat, or supervisor of game and game fish, Box 384, Seattle.

[93] No open season on waterfowl on Columbia or Snake Rivers or within a quarter of a mile of their shores in Benton, Columbia, Douglas, Franklin, Garfield, Grant, Kittitas, Klickitat, Walla Walla, Whitman, and Yakima Counties.

Bag limits and possession: One deer, 1 elk, a season; 5 each of prairie chickens, sharp-tailed grouse, ruffed grouse, blue grouse, and Chinese or Mongolian pheasants, 10 each of quail and Hungarian partridges, a day or in possession, but if more than one day's limit is desired any number may be possessed if each day's kill is tagged by a warden that day. Twenty ducks, geese, brant, Wilson's snipe a week (week ends at midnight Saturday), but not more than 8 geese, 8 brant, a day; 30 ducks, geese, and brant in possession; 25 coots, 25 sora, and 25 in all of other rails and gallinules but not more than 15 of any one species of rails (other than sora) and gallinules a day. Possession during close season permitted upon filing with county game commission description and number of each kind of game, which must be tagged or stamped by commission for identification, but rails may only be possessed until December 10 and other migratory game birds east of Cascades until January 10 and west of Cascades until January 25.

Interstate transporation: Export of all protected game prohibited, except that nonresident licensee may carry with him one day's limit of game birds upon attaching an affidavit that they were lawfully killed by himself and are not being exported for sale.

Game taken outside of State when accompanied by affidavit of chief game official may be possessed at any time for noncommercial use, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season.

Sale: Sale of all protected game prohibited.

WEST VIRGINIA[94]

Open seasons:[94]	*Dates inclusive*
Rabbit (except on own land, at any time)	Oct. 15–Dec. 31.
Squirrel (except red squirrel, no close season)	Sept.16–Nov.30.[95]
Raccoon, opossum	Nov. 1–Jan. 31.
Ruffed grouse (pheasant), wild turkey	Oct. 15–Nov. 30.
Quail (Virginia partridge)	Nov. 1–Nov. 30.
Duck, goose, brant, coot, Wilson's snipe or jacksnipe	Sept. 16–De . 31.
Woodcock	Nov. 15–Dec. 15.
Rail (ortolan) and gallinule, other than coot	Sept. 1–Nov. 30.

No open season: Elk (1935); deer (Dec. 1, 1930); doves, imported pheasants, Hungarian partridges, capercalzie, and other introduced foreign game birds; swans, wood duck, bitterns, sandhill cranes, grebes, gulls, herons, jaegers, loons, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Game, $15; fish, $5. Resident: Game and fish, $1.25; resident, big game, $5. Issued by county clerk. License tag must be displayed between the shoulders on outer garment of licensee. Aliens not permitted to hunt or fish, or to possess firearms. License not required of minors under 15. Landowner, his resident children and tenants, may hunt or fish on own land during open season without license. Unlawful to hunt or fish on lands of another without written permission of owner.

Bag limits and possession: One wild turkey a day, 2 a season; 6 rabbits a day, 40 a season, except rabbits killed on own premises; 6 squirrels a day, 30 a season; 8 quail a day, 50 a season; 3 ruffed grouse a day, 15 a season; 15 ducks, 4 geese, 8 brant, 4 woodcock, 20 Wilson's snipe, 25 coots, 25 sora, and 25 in all of other rails and gallinules, but not more than 15 of any one species of rails (other than sora) and gallinules a day. Possession of migratory birds permitted during first 10 days of close season; other game legally taken may be possessed at any time.

Interstate transportation: Export prohibited of elk, deer, squirrels, quail, ruffed grouse (pheasant), wild turkeys, geese, brant, ducks, provided a nonresident licensee may personally take with him out of the State, during any open season, one day's limit of game animals or birds lawfully taken by himself.

Game taken outside of State and legally exported may be possessed at any time, except that migratory game birds may be possessed only during the open season where taken and first 10 days of close season.

Sale: Sale prohibited of all protected game except rabbits.

WISCONSIN

Open seasons:	*Dates inclusive*
Deer (male, not less than 1 year old), in Pierce, Barron, Chippewa, Rusk, Price, Lincoln, Langlade, Oconto, and all counties north thereof (season closed in odd, open in even years)	Dec. 1, 1930.
In rest of State	No open season.
Rabbit (except in Crawford County, no close season)	Nov. 1–Jan. 1.
Squirrel (see exception)	Nov. 1–Jan. 1.
Exception: In Dodge, Fond du Lac, Jefferson, Kenosha, Milwaukee, Ozaukee, Racine, Walworth, Washington, and Waukesha Counties	No open season.
Duck,[96] goose, brant, coot,[96] or mud hen, Wilson's snipe or jacksnipe	Sept. 16–Dec. 20.
Rails and gallinules, other than coot	Sept. 16–Nov. 30.

No open season: Elk, moose, does and fawns, bear, quail, pheasants[97] (Chinese, English, Mongolian); Hungarian partridges, prairie chickens or pinnated grouse, sharp-tailed grouse, partridges, spruce hens, doves, woodcock, swans, wood duck, eider ducks, auks, bitterns, little brown, sandhill, and whooping cranes, grebes, guillemots, gills, herons, loons, murres, terns, and all shore birds (except Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: all game, $50; all game (except deer), $25; fish, $3 (3 shipping coupons, $2 additional); fishing license not required of persons under 16; settler, $1 (deer tag, 50 cents); guide, $1. Issued by commission. Resident: Game, $1 (deer tag, 50 cents additional); issued by county clerks.

Hunting licenses not issued to persons under 15 or to aliens. Hunting prohibited in fields of growing grain or on lands of another without consent of owner.

Bag limits and possession: One male deer in even years (1930); 5 squirrels a day (except in Burnett County, no limit), 5 rabbits a day (except in Crawford County, no limit); 4 woodcock, 8 geese, 8 brant a day. Ducks (including coot or mud hen), 15 a day; snipe, rail, rice hen, gallinule, 15 a day, but not more than 25 in all of rails (other than sora) and gallinules a day.

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[94] *West Virginia:* Commission by order may change, modify, or suspend open season, or change the bag limit on any game.

[95] Commission, on petition of 150 licensed hunters in any county, may open squirrel season in such county not earlier than Sept. 1 and close season at a correspondingly earlier date.

[96] *Wisconsin:* Ducks and coots or mud hens may not be hunted on Wednesday of each week during open season.

[97] In towns of Oconomowoc, Summit, Ottawa, and Mukwonago in Waukesha County and in towns of Ixonia, Sullivan, and Concord in Jefferson County, English pheasant cocks may be taken on Mondays only in October—Oct. 7, 14, 21, and 28—limit, 2 cocks a day.

Possession at any time of deer duly tagged permitted for private use by person killing it.

Possession at any time prohibited of game by person without hunting license or scientist's certificate.

Interstate transportation: Export of all protected game prohibited, except that nonresident licensee may transport, between Dec. 1 and 10, inclusive (1930), 1 deer duly tagged, if he accompanies shipment and may take in his personal possession, openly, a mixed bag of not more than 20 game birds legally killed, but not more than the bag limit for one day of any one variety.

Game taken outside of State and legally exported may be possessed as authorized by permit from conservation commissioner, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season.

Sale: Sale of all protected game prohibited (except rabbit). Rabbits may be sold during open season.

WYOMING

Open seasons:[98]	*Dates inclusive*
Deer (male, with forked horns) (see exceptions)	No open season.
Exceptions: In Converse, Hot Springs, Natrona, Sweetwater, Uinta, Washakie, and parts of Fremont and Johnson Counties	Oct. 1–Oct. 15.
In Park and Teton Counties, and part of Fremont County (except white-tailed deer in Teton County, no open season)	Sept. 15–Nov. 15.
In Big Horn County	Oct. 16–Oct. 31.
In Platte and Carbon Counties and part of Albany County	Oct. 10–Oct. 15.
In Lincoln and Sublette Counties	Oct. 1–Nov. 15.
In Campbell, Crook, and Weston Counties	Oct. 1–Oct. 31.
Elk, in parts of Lincoln and Sublette Counties	Oct. 1–Nov. 15.
In Sheridan County and part of Johnson County	Oct. 1–Oct. 15.
In Big Horn County	Oct. 13–Oct. 15.
Male mountain sheep, in Park, Teton, and Uinta Counties and part of Fremont County	Sept. 15–Nov. 15.
In Lincoln and Sublette Counties	Oct. 1–Nov. 15.
Bull moose, in Fremont, Lincoln, Sublette, and Teton Counties and part of Park County	Oct. 1–Nov. 15.[99]
Antelope, in Fremont, Park, Sublette, Lincoln, Uinta, Sweetwater, Carbon, Platte, and Teton Counties	Sept. 29–Oct. 4.[99]
In Campbell, Crook, and Weston Counties	Sept. 29–Oct. 1.[99]
Sage hen or sage chicken (see exception)	Aug. 11–Aug. 18
Exception: In Albany, Laramie, Niobrara, Sheridan, and Teton Counties, and in part of Converse County	Aug. 1, 1930.
Grouse (see exceptions)	Sept 1–Oct. 1.
Exceptions: In Johnson and Sheridan Counties	Oct. 1–Oct. 31.
In Fremont, Lincoln, Park, Sublette, Sweetwater, Teton, and Uinta Counties	Sept. 15–Nov. 15.
In Albany, Carbon, and Niobrara Counties	Sept. 1, 1930.
Pintail grouse, in Fremont and Teton Counties (except on national forest areas, Sept. 1–Oct. 1)	Sept. 1, 1930.
Duck, goose, brant, coot, Wilson's snipe or jacksnipe	Sept. 16–Dec. 16.

No open season: Antelope (except as above); buffalo; does and fawns; (elk except as above); moose (except as above), 1931; mountain sheep (except as above) 1931; pheasants, quail, Hungarian partridges, prairie chickens (1939); doves, swans, wood duck, rails, gallinules, bitterns, little brown and sandhill cranes, grebes, gulls, herons, loons, terns, and all shore birds (except Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: General hunting and fishing, $60 (not issued to minors under 16); game birds, $10 (not issued to minors under 16); fishing, $4 (not issued to minors under 14). Nonresident hunting big game must be accompanied by a guide, except that two persons may accompany one guide. Nonresident special elk license, $40 (not required where nonresident general license has been procured). Nonresident, special mountain sheep license, $15. Nonresident special bear permits, $25 (authorizes killing of 3 bears). Resident: General hunting and fishing, $5 (not issued to minors under 16); game birds, $2 (not issued to minors under 13); fishing, $1.50 (not required of Civil War veterans or minors under 16). Resident, special elk and special deer licenses, $2.50 each, and mountain sheep, $5, but not required where general hunting and fishing licenses have been procured. Guide license, citizen only, $25 (bond, $500). Permit to photograph game or birds Jan. 1 to Apr. 30, inclusive, under supervision of commission, $5. Taxidermist, $10. Resident alien, fishing, $7.50; resident alien, game bird, $10. Nonresident alien, fishing, $12.50. Alien licenses not issued to minors under 14. Hunting predatory animals or bears in national forests, fee $1 for each dog. Licenses and permits issued by State game and fish commissioner, his chief assistant, chief clerk, assistant and deputy game and fish commissioners, superintendents of fish hatcheries, justices of the peace, and persons authorized by State game and fish commission. Unlawful to hunt on inclosed lands of another without permission.

Bag limits and possession: One deer, 1 elk, 1 mountain sheep, 1 bear a season; under special permits,[99] 1 bull moose, 1 antelope, 3 bears (nonresident), a season; possession limited to 15 game birds, of which not more than 6 may be sage hens, sage chickens, or grouse. Federal limits on killing migratory game birds: 25 ducks, 8 geese, 8 brant, 20 Wilson's or jack snipe, 25 coots, a day.

Interstate transportation: Export of all protected game prohibited, provided game may be exported if properly tagged by a justice of peace, assistant or deputy commissioners, or superintendents of fish hatcheries; fee, 50 cents. Game tags issued under affidavit that game was lawfully killed, and, if for edible portion, that it is not for sale. Not more than 50 ducks, 16 geese, 16 brant, 40 Wilson's snipe, 50 coots or 50 in all of rails and gallinules but not more than 30 of any one species may be exported by one person in any one calendar week.

Game taken outside of State and legally exported may be possessed at any time, except that migratory game birds may be possessed only during open season where taken and first 10 days of close season. Person possessing game during close season in State must show lawful taking.

Sale: Sale of all game of State prohibited, except edible portion when properly tagged. Justices of the peace, assistant and deputy commissioners, or superintendents of fish hatcheries issue tags (fee, 50 cents) under affidavit of lawful killing. Sale of migratory birds prohibited.

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[98] *Wyoming:* State game and fish commission may suspend open season in any county or district of State on any species of game when threatened with extinction.

[99] Commission may issue not to exceed 50 permits for bull moose. Fees, resident citizen, $50; nonresident or noncitizen, $100; limit, 1 a season. Commission may also issue special permits for antelope in counties having open seasons. Fees, resident citizen, $2.50; nonresident or noncitizen, $50; limit, 1 a season.

CANADA

The migratory-birds convention act of August 29, 1917, as amended in 1919, 1921, and 1925, and the regulations thereunder promulgated by the Governor General in council, are similar to the migratory-bird treaty act and regulations in that they give effect to and conform with the provisions of the treaty between the United States and Great Britain for the protection of migratory birds in the United States and Canada. Full text of the regulations, as amended, will be found in a publication issued annually by the Commissioner of National Parks of Canada, Ottawa.

Canada also has a general law prohibiting export of deer carcasses or parts thereof (except as to cured deer heads and hides of deer and except carcasses and parts of deer raised on private preserves); and wild turkey, quail, partridge, prairie fowl, and woodcock; but subject to Provincial laws and under a permit from the collector of customs a nonresident licensee, on not more than two occasions during one calendar year, may export, during the open season in the Province where killed and within 15 days thereafter, not more than the whole or parts of 1 moose and 3 deer not being moose, legally shot by him for sport and not for gain or hire; provided, however, that a nonresident licensee may export from Yukon Territory in one year the hides and heads of not more than 2 moose, 4 caribou, and 4 deer not being moose or caribou. Such licensee, at any port of export, may make an export entry in duplicate of such deer or part thereof upon subscribing before the collector or other officer of customs a declaration to be annexed to said export entry, producing his license or permit for shooting the deer to the collector or other officer of customs, who shall indorse thereon a description of the quantity and parts entered for exportation, and thereupon, if satisfied as to the identity of the sportsman and that the exportation is not prohibited, may issue his permit under the seal of the customhouse for the export of the deer or parts thereof, which permit must accompany the shipment. The ports of export are Halifax and Yarmouth, Nova Scotia; McAdam Junction, St. John, and St. Stephen, New Brunswick; Montreal, Quebec, Sherbrooke, Beebe Junction, and St. Armand, Quebec; Bridgeburg, Brockville, Kingston, Ottawa, Port Arthur, Prescott, Niagara Falls, Sarnia, Sault Ste. Marie, Toronto, and Windsor, Ontario; Emerson, Manitoba; North Portal, Saskatchewan; Coutts, Alberta; Kingsgate and Waneta, British Columbia; Whitehorse, Yukon Territory, and all other customs ports and outports on the frontier of the United States; and such others as the Minister of Customs may designate.

ALBERTA

Open seasons: [1, 2]	*Dates inclusive*
Deer (see exception), moose, caribou (must have horns at least 4 inches long)	Nov. 1–Dec. 14.[3]
Exception: Deer; south of North Saskatchewan River, and East of Canadian Pacific Railway from Edmonton to Macleod	No open season.
Mountain sheep (male), mountain goat (must have horns at least 4 inches long)	Sept. 1–Oct. 31.
Bear (except cubs or bear with cub)	Sept. 1–June 14.
Sharp-tailed grouse, north of Red Deer River only	Oct. 1–Oct. 15.
European gray partridge (Hungarian partridge)	Oct. 1–Nov. 15.
Open seasons—Continued.	*Dates inclusive*
Duck, goose, Wilson's snipe or jacksnipe, coot, gallinule:	
North of Clearwater and Athabaska Rivers	Sept. 1–Dec. 14.
South	Sept. 15–Dec. 14.

No open season: Antelope, elk or wapiti, buffalo; females of deer, moose, mountain sheep, young of all big game with horns less than 4 inches in length; grouse (except sharp-tailed grouse north of Red Deer River), partridges, prairie chickens, ptarmigan; pheasants, doves, swans, wood duck, rail, bitterns, little brown, sand-hill, and whooping cranes, grebes, gulls, herons, jaegers, loons, terns, and all shore birds (except Wilson's snipe or jacksnipe).

Hunting licenses: [2] Nonresident: General, $50; bird, $5. Resident: Big game, $1; birds, $2.25, not required of farmer or member of family residing with him on farm nor of residents residing north of fifty-fifth parallel; guide, $2.50 (guide may not act for more than three persons on any trip). Special license: Nonresident, $50; resident, $5 (issued to holders of general licenses and authorizes taking of deer, moose, and caribou in Rocky Mountain Forest Reserve of Alberta, Sept. 1 to Oct. 31, inclusive). Taxidermist, $5. Issued by minister of agriculture. Consent of owner or occupant required for hunting on inclosed lands of another.

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[1] *Alberta:* Seasons on game birds fixed by lieutenant governor in council and may be obtained from game commissioner, Edmonton.

[2] Resident north of fifty-fifth parallel, when necessary to provide food for his family, may kill big game (other than buffalo and elk) and scoters.

[3] Deer, moose, and caribou (big game must have horns at least 4 inches long), open season under special license in Rocky Mountain Forest Reserves of Alberta, Sept. 1 to Oct. 31, inclusive (see Hunting licenses).

Bag limits and possession: Deer, moose, caribou, mountain sheep, mountain goat, bear, 1 of each species a season; sharp-tailed grouse, 5 a day, 25 a season; Hungarian partridges, 15 a day, 75 a season; 30 ducks a day, 200 a season; 15 geese, 25 coots, 25 Wilson's snipe, a day. Migratory game birds legally taken during the open season may be possessed until Mar. 31.

Export: Export of all protected game prohibited, except that minister of agriculture may grant permits for export of game at rate of $5 for each head of big game and $1 a dozen for game birds. The holder of a general nonresident license may take with him out of Province as trophies, heads, skins, and hoofs of big game legally killed by him. Any person may export mounted or branded heads at a fee of $1 a head. Export of migratory birds prohibited during close season.

Sale: Sale of migratory game birds and flesh of all other game prohibited. Heads of big game before being sold must be stamped by minister of agriculture at fee of $5 for elk, caribou, moose, mountain sheep, and $2 each for deer and mountain goat.

BRITISH COLUMBIA

Open seasons:[4]	*Dates inclusive*
Bull moose in Atlin, Fort George, and Cariboo electoral districts and north main line Canadian National Railway in Omineca electoral district	Sept. 1–Dec. 15.
In Columbia electorial district (except west of Columbia River)	Oct. 1–Oct. 31.
Bull caribou, in eastern district except in Mackenzie and Skeena electoral districts, Cariboo electoral district west of Fraser River, and except south of main line Canadian Pacific Railway	Sept. 1–Dec. 15.
Bull elk (wapiti) in Fernie and Cranbrook electoral districts and in Columbia electoral district (except west of Columbia River)	Oct. 1–Oct. 15.
Male mountain sheep, in eastern district north of Canadian National Railway and in Cariboo and Lillooet electoral districts south of fifty-second parallel and west of Fraser River, and in Fernie, Cranbrook, and Columbia electoral districts	Sept. 1–Nov. 15.
Mountain goat in eastern district (except between Columbia and Fraser Rivers and south of Canadian Pacific Railway from Revelstoke to Ashcroft)	Sept. 1–Nov. 30.
In western district except Vancouver Island)	Sept. 14–Nov. 30.
Male deer (mule, white-tail, coast) in eastern district (does, Nov. 15–Nov. 30) (see exception)	Sept. 1–Nov. 30.
Exception: White-tailed deer in North and South Okanagan and Similkameen electoral districts and west of summit of Midway Mountains in Grand Forks-Greenwood electoral district	No open season.
In western district (does, Nov. 15–Nov. 30) (see exceptions)	Sept. 15–Nov. 30.
Exceptions: Bucks only, in North and South Saanich and Highland districts on Vancouver Island	Sept. 14–Oct. 31.
Deer on Queen Charlotte Islands and Hornby Island	No open season.
Bear (except white or Kermodei bear) in eastern district	Sept. 1–June 30.
In western district	Sept. 14–June 30.
Band-tailed pigeon, in western district only	Sept. 15–Sept. 30.
Duck, goose, brant, coot, Wilson's snipe or jacksnipe: Eastern district[5]	Sept. 15–Dec. 31.
Duck, goose, coot, Wilson's snipe or jacksnipe: Western district[5]	Oct. 15–Jan. 31.
Black brant: Western district[5]	Nov. 15–Feb. 28.

No open season: Buffalo; young of mountain goats; moose; caribou; elk; deer; and mountain sheep, except males over 1 year of age as above; rail, swans, wood duck, little brown and sand-hill cranes, auklets, auks, bitterns, fulmars, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, terns, and all shore birds (except Wilson's snipe).

Hunting and fishing licenses: Nonresident: General, $25 and $25 additional for each grizzly bear, moose, mountain sheep, wapiti, or caribou, $15 additional for each black or brown bear, mountain goat, or mule deer, and $5 additional for every deer of any other species shot by him; angling, season $10; British subject, birds $5 a week. Resident British subjects or farmers as defined under game act, and members of army, navy, air forces, or militia on duty in Province: Deer and birds, $2.50; big game and birds, $5. Big game, birds, and trapping, $10 (holder must report within 2 months after expiration of license number of big game or fur animals taken); resident alien, $10 (big game and game birds only); guide, $5; taxidermist, $5. Issued by warden or any person authorized by him.

No fee required of farmer holding more than 10 acres of land or members of family for license to hunt birds and deer during open season on land on which he resides. Free license granted to resident prospector under certain conditions upon production of free miner's certificate. No license issued to person under 18 without written consent of parent or guardian, and then to hunt with firearms only under supervision of licensed adult. Unlawful to hunt on cultivated, cleared, or inclosed land without owner's consent.

Badge to be worn by licensee. Firearms not to be carried without license.

Bag limits and possession: One moose, 2 caribou (except in eastern district south Canadian National Railway, limit 1), 1 elk (wapiti), 2 mountain sheep (except in Fernie, Cranbrook, Columbia, Cariboo, and Lillooet electoral districts, limit 1), 2 mountain goats, 2 deer (1 buck and 1 doe, or 2 bucks) in eastern district, 3 (2 bucks and 1 doe, or 3 bucks), in western district, 2 grizzly bears, 3 bears of any other species a season; 10 band-tailed pigeons a day, 50 a season; 20 ducks a day, 150 a season; 10 geese a day, 50 a season; 10 brant a day, 50 a season; 25 Wilson's snipe a day, 150 a season; 25 coots a day, 150 a season. (Limits on other species of game fixed by regulations of lieutenant governor in council.) Game may be possessed for 2 weeks after close of open season Unlawful for a dealer in skins to possess the skin of any wapiti (elk) or deer.

Export: Export prohibited of all game except under permit of provincial game warden.

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[4] *British Columbia:* Regulations prescribing seasons, bag limits, and restrictions on sale of upland game birds for season 1929–30 are adopted by lieutenant governor in council. Full information may be had from provincial game commissioner, Vancouver.

[5] *Western district* includes that portion of Province west of summit of Cascades and south of Atlin electoral district, except for migratory birds east of easterly railway yard limit of Alta Lake Railway Station on Pacific Great Eastern Railway. *Eastern district* includes balance of Province.

Sale: Sale of migratory game birds prohibited and of all other game, except under regulations of lieutenant governor in council; provided, bull moose and bull caribou may be sold in Atlin and Omineca electoral districts from Sept 1 to Dec 15, and bears (except white or Kermodei bears) in eastern district from Sept. 1 to June 30, and in western district from Sept. 15 to June 30.

MANITOBA

Open seasons:[6]	*Dates inclusive*
Deer, moose, caribou, or reindeer (males)	Nov. 21–Nov. 30.
Ptarmigan	Oct. 1–Oct. 20.
Duck, goose, brant, coot, Wilson's snipe (see exception)	Sept. 15–Nov. 30.
Exception: Duck, north fifty-third parallel	Sept. 1–Nov. 30.

No open season: Bison or buffalo, elk or wapiti, antelope or cabri, females and young of big game; doves, prairie chicken, partridge, ruffed grouse, quail, pheasants, Hungarian partridges, introduced game birds; rail, swans, wood duck, eider ducks, woodcock, bitterns, little brown, sand-hill, and whooping cranes, grebes, gulls, herons, jaegers, loons, terns, and all shore birds (except Wilson's snipe or jacksnipe).

Hunting licenses: Nonresident alien, big game, $25; birds, $25. Nonresident British, big game, $15; birds, $10. Resident, big game, $5; birds, $2. Issued by minister of agriculture. License to hunt deer not issued after November 20. Hunting prohibited on inclosed or cultivated land or land covered by buildings or water, without consent of owner. No license required of farmers or members of family to hunt on farm on which they reside. Holder of resident bird license required, on or before December 15, to return license with sworn statement that he has not violated the act.

Bag limits and possession: One in all of deer, moose, and caribou a season; 15 ptarmigans a day, 50 a season; prairie chickens, partridges, or ruffed grouse, 25 in all a season; 20 ducks a day in September, 40 a day in October and November, 200 a season; 10 geese, 15 brant, 25 coots, and 25 Wilson's snipe a day. Possession of ptarmigans, prairie chickens, partridges, and grouse allowed for 10 days after close of hunting season and of migratory game birds until Mar. 31. Venison for private use may be possessed at any time on proof of legal killing. Heads and hides of big game legally taken, within or without Province, may be possessed at any time.

Export: Export prohibited of all protected game except under permit issued by department of agriculture. No permit may be issued for export of ptarmigans, prairie chickens, partridges, grouse, geese, ducks, or entire carcass of any moose, caribou, or deer; provided, nonresident licensee under permit issued free may export carcass of moose, caribou, or deer, and not more than 50 geese and 50 ducks killed by him. (No ducks may be exported before Oct. 1.) Export of migratory birds prohibited during close season.

Sale: Sale of all protected game prohibited except heads and hides of big game.

Miscellaneous: Big-game hunter must wear complete outer suit and cap of white material.

NEW BRUNSWICK

Open seasons:	*Dates inclusive*
Deer (see exception)	Sept. 15–Nov. 30.
Exception: On Grand Manan, Campobello, and Deer Island	No open season.[7]
Bull moose (antlers must have 10 points)	Oct. 1–Nov. 30.
Duck, goose, brant, rail, coot, gallinule (see exception)	Sept. 15–Dec. 31.
Exception: Islands in Grand Manan group	Oct. 15–Jan. 31.
Woodcock, jacksnipe or Wilson's snipe (see exception)	Oct. 1–Nov. 30.
Exception: Islands in Grand Manan group	Oct. 15–Nov. 30.

No open season: Caribou (Oct. 1, 1930); calf moose under 3 years and cow moose; pheasants, partridges, swans, wood duck, auks, bitterns, fulmars, gannets, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwater, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident: Big game, $50 (1 bull moose, 2 deer, 2 bears); $25 (2 deer); special license, $25 (2 bears, Apr. 1–June 30); bird, $25; trout, $10; salmon, $25. Resident: Big game; $3 (1 bull moose, 2 deer); $2 (2 deer); taxidermist, $1; guide, $1; camp help, $1. Special license for salmon in reserved waters of the Restigouche: Nonresident, $25 a day; resident, $5 a day. Issued by minister of lands and mines and authorized vendors. Resident big-game licensees must report number of game animals killed thereunder not later than December 10, and return license and unused tags. Big-game license not issued to persons under 18. Nonresident licensee must have registered guide, and not more than two hunters may accompany one guide.

Bag limits and possession: Two deer, 1 moose (lumber camp limited to 2 moose and 4 deer) a season; 25 ducks, 15 geese, 15 brant, 25 in all of rails, coots, gallinules, and 25 Wilson's snipe a day; 8 woodcock a day, 125 a season. Game may be kept for personal use in cold storage during close season under permit, but migratory game birds may not be possessed after Jan. 31.

Export: Export of all game prohibited, except game killed by nonresident licensee may be exported, within 15 days after being killed, under permit from Canadian customs office.

Sale: Sale of all game prohibited, except that a licensed hunter may sell moose or deer that he has lawfully killed. Keepers of hotels, inns, etc., may serve game during open season and 15 days thereafter. Hides and skins of animals may be sold under license by nonresidents or aliens, fee, $25, and residents, fee, $5.

NORTHWEST TERRITORIES[8]

Open seasons:	*Dates inclusive*
Deer and moose (males only), mountain goat	Sept. 1–Mar. 31.
Mountain sheep, caribou	Sept. 1–Feb. 28.
Partridge, prairie chicken, ptarmigan, and other grouse	Sept. 1–Dec. 31.
Duck, goose, brant, rail, coot, gallinule, Wilson's snipe	Sept. 1–Dec. 14.

No open season: Buffalo or bison; musk-oxen, wapiti or elk, does; females of moose, caribou, mountain sheep, and mountain goats with young, and young of any such animals; swans; auks, bitterns, little brown and sand-hill cranes, fulmars, grebes, guillemots, gulls, jaegers, loons, murres, terns, and all shore birds (except Wilson's snipe or jack snipe). Arctic Islands Preserve, Peel River, Yellowknife, and Slave River preserves, reserved as exclusive hunting and trapping grounds for native Indians, Eskimos, and half-breeds. All hunting prohibited in Thelon Game Sanctuary.

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[6] *Manitoba:* Open season may be shortened or closed or bag limits reduced by order-in-council.

[7] *New Brunswick:* Minister of lands and mines may issue license (fee, $1) to resident of Grand Manan, Campobello, or Deer Island to take 1 deer, Oct. 15–Nov. 15.

[8] "*Northwest Territories* means the northwest territories formerly known as Rupert's Land and the northwestern territory (except such portions thereof as are included in the Provinces of Ontario, Quebec, Manitoba, Saskatchewan, and Alberta and the Yukon Territory), together with all British territories and possessions in North America and all islands adjacent thereto not included within any Province, except the Colony of Newfoundland and its dependencies."

Hunting and trapping licenses: Nonresident, $150. Nonresident British subject: General, $75; game birds, $5. Resident, $2. Trading or trafficking in game: Nonresident, $300; nonresident British subject, $150; resident, $5. Issued by director of Northwest Territories. Permit from commissioner required to establish trading post. Licensee, on or before July 1, must return license to nearest game officer or warden with a statement of number of each kind of game killed, or trafficked in. Native-born Indians, Eskimos, or half-breeds bona-fide residents of Northwest Territories may hunt without a license.

Bag limits and possession: Two bull moose, 2 male deer, 4 caribou; mountain sheep, 2 of any species, 3 in all; mountain goat, 2 of any species a season; 25 ducks, 15 geese, 15 brant, 25 in all of rails, coots, and gallinules, and 25 Wilson's snipe a day. Migratory game birds legally taken during open season may be possessed until Apr. 14.

Export: Export of the meat or the raw skins of game animals prohibited, except under permit from minister or authorized officer.

Sale: Sale of migratory game birds during close season and of all other game illegally taken prohibited.

NOVA SCOTIA

Open seasons:	*Dates inclusive*
Bull moose (except on Cape Breton Island, no open season), male deer	Oct. 16–Nov. 15.[9]
Hare, rabbit	Nov. 1–Feb. 28.
Duck, goose, brant, rail, coot, gallinule (see exceptions)	Oct. 1–Jan. 15.
Exceptions: Goose, brant, in Shelburne, Queens, and Halifax Counties only persons holding license from minister)	Dec. 1–Feb. 14.
Duck, rail, in Cumberland County	Sept. 15–Dec. 31.
Woodcock, Wilson's snipe or jacksnipe	Oct. 1–Nov. 30.

No open season: Caribou, does, cow moose, and young of deer and moose under 2 years of age; Canada grouse (spruce partridges) ruffed grouse (birch partridges), Hungarian partridges, pheasants; swans, wood duck, auks; bitterns, fulmars, gannets, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting licenses: Nonresident or alien: All game, $50; birds and small game, except woodcock and snipe, $15. Resident: Big game, $2, guide, $2. Taxidermist, $5. Issued by minister of lands and forests and agents. Licenses not issued to persons under 18.

Bag limits and possession: One deer, 1 moose a season; 25 ducks, 15 geese, 15 brant, 25 in all of rails, coots, and gallinules, 25 Wilson's snipe a day; 8 woodcock a day, 125 a season. The green hide or fresh meat of moose and deer may be possessed Oct. 16 to Nov. 20, and migratory game birds legally taken during open season may be possessed until the last day of February.

Export: Export prohibited of all protected game, except that holder of nonresident general license may ship out of Province under license tag 1 moose lawfully shot by himself. Hares or rabbits lawfully killed may be exported at any time.

Sale: Sale of deer, moose, caribou, pheasants, blackcock, capercailzie, Canada grouse (spruce partridge), chukar partridge, ruffed grouse, Hungarian partridge, and all migratory game birds, prohibited. Rabbits may be sold Nov. 1 to Mar. 1.

ONTARIO

Open seasons:[10]	*Dates inclusive*
Deer, bull moose, north of main line Canadian National Railway, between Quebec and Manitoba boundary lines	Sept. 15–Nov. 25.
South of Canadian National Railway to Mattawa River and Canadian Pacific Railway to Heron Bay, north shore Lake Superior	Oct. 20–Nov. 25.
South Canadian Pacific and Heron Bay and north Lake Nipissing and French River (see exception)	Nov. 1–Nov. 25.
Exception: On St. Joseph Island, Algoma district	Nov. 10–Nov. 25.
South of French and Mattawa Rivers (except in Leeds, Grenville, Dundas, Stormont, Glengarry, and Carleton Counties, and in Bruce, Grey, Simcoe, and York Counties, and territory south and west thereof no open season)	Nov. 5–Nov.20.
Hare	No close season.
Woodcock	Sept. 15–Nov. 30.
Duck, goose, brant, Wilson's snipeor jacksnipe, rail, coot, gallinule:	
North and west of French and Mattawa Rivers and in all Georgian Bay ters (see exception)	Sept. 1–Dec. 15.[11]
Exception: Eider duck, north of Quebec, Cochrane, Winnipeg line of Canadian National Railway, only	Sept. 1–Dec. 15.
South of French and Mattawa Rivers, but not including Georgian Bay waters	Sept.15–Dec.15.[11]

No open season: Caribou, cow and calf moose and moose under 1 year of age; black or gray squirrels, quail, ruffed grouse or partridges, pheasants or prairie fowl, wild turkeys; doves, swans, wood duck,[11] eider duck (except as above), auks, bitterns; little brown, sand-hill, and whooping cranes; gannets, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, terns, and all shore birds (except woodcock and Wilson's snipe).

Hunting and fishing license: Nonresident: Game, $41; game birds and rabbits, $21; angling, $5.50; special, $10.50 (weekly license, for Lake Nipigon, Frazier Creek, and Nipigon River, north and west of Lake Helen); not required of children under 12 when accompanied by licensed nonresident, but catch is included in daily limit of such licensee. Resident, moose, $6; deer, $4; camp license, $4 (allows 1 deer to 6 residents for food in camp); game, $2 (required only in Brant, Elgin, Essex, Haldimand, Halton, Kent, Lambton, Lincoln, Middlesex, Norfolk, Oxford, Peel, Perth, South Huron, South Wellington, Waterloo, Welland, Wentworth, and York Counties); angling, $0.50 (daily license, Eugenia Game Preserve), special, $5.50 (good for 2 weeks in Lake Nipigon, Frazier Creek, and Nipigon River north and west of Lake Helen). Guide, $2. Issued by department of game and fisheries.

Bag limits and possession: One deer, 1 bull moose, a season; 25 ducks a day, 200 a season; 15 geese, 15 brant, 25 in all of rails, coots, and gallinules, and 25 Wilson's snipe a day. Eight woodcock a day, 125 a season; two or more persons hunting together under license may kill an average of 1 deer each. Possession of all game legally taken permitted during open season and until Mar. 31.

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[9] *Nova Scotia:* Every person killing a deer or moose must, within 10 days, make a written and signed report to minister showing his address, when and where such animal was killed, and its sex.

[10] *Ontario:* Lieutenant governor in council may alter current close season on any game animal or bird diminished in numbers.

[11] Lieutenant governor in council may permit the taking of wood ducks under special regulations.

Export: The export of all wild game animals and birds is prohibited; provided, 1 deer, 100 ducks, 1 bull moose, and under export permit bears or bear pelts, may be exported under nonresident hunting license if shipping coupon and, if required, affidavit of lawful killing be attached and contents of packages be open to view. Minister may issue permit for export of game, dead or alive, at any time, except migratory birds, during close season.

Sale: Sale or purchase of deer, moose, migratory game birds, quail, grouse, introduced pheasants, and Hungarian partridges prohibited.

PRINCE EDWARD ISLAND

Open seasons:	*Dates inclusive*
Hare, rabbit	Nov. 1–Feb. 1.
Partridge (open in odd, closed in even years)	Oct. 15–Nov. 15.
Duck, goose, brant, rail, coot, gallinule	Sept. 1–Dec. 14.
Woodcock, jacksnipe or Wilson's snipe	Sept. 15–Nov. 30.

No open season: Pheasants, swans, wood duck, bitterns, little brown cranes, gannets, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, shearwaters, terns, and all shore birds (except woodcock and Wilson's snipe or jacksnipe).

Hunting and fishing licenses: Nonresident, Game: Fee, $5; sons, brothers, and sisters of residents returning for visit, $2.50; guest permit fee, $2.25 per week. Issued by game inspector or justice of peace. Hunting on inclosed lands without permission of owner prohibited. Nonresident, angling fee, $2 (not required of son, daughter, sister, or brother of a permanent resident of Province). Issued by Provincial treasurer or game inspector.

Bag limits and possession: Three partridges a day (in 1929); 25 ducks, 15 geese, 15 brant, 25 in all of rails, coots, and gallinules, and 25 Wilson's snipe a day; 8 woodcock a day, 125 a season. Migratory game birds legally taken in open season may be possessed until January 31.

Export: Export prohibited of all game, provided, nonresident licensee may carry out of Province 12 birds killed by himself if tagged and carried open to view. Export of migratory birds prohibited during close season.

Sale: Game lawfully killed (except migratory birds) may be sold during open season.

QUEBEC

Open seasons:	*Dates inclusive*
Bull moose (see exception)	Sept. 10–Dec. 31.
Exception: South of St. Lawrence River	Sept. 20–Dec 31.
Deer	Sept. 1–Nov. 30.
Hare	Oct. 15–Jan. 31.
Bear	Aug. 20–June 30.
Birch or spruce partridge	Sept. 1–Dec. 15.
White partridge or ptarmigan	Nov. 1–Jan. 31.
Duck, goose, brant, rail, coot, gallinule, woodcock, jacksnipe or Wilson's snipe	Sept. 1–Dec. 15.

No open season: Caribou, cow moose, young of deer and moose, swans, wood duck, eider ducks, auks, bitterns, fulmars, gannets, grebes, guillemots, gulls, herons, jaegers, loons, murres, petrels, puffins, shearwaters, terns, and all shore birds (except woodcock and Wilson's snipe).

Hunting licenses: Nonresident: General, $25 (members of incorporated hunting clubs, $10). Resident, not British subject, $5, resident, deer, $1, moose, $1. Resident British subject not hunting for own use must obtain special license. Issued by minister of colonization.

Bag limits and possession: Two deer, 1 moose, a season; 25 ducks, 15 geese, 15 brant, 25 in all of rails, coots, and gallinules, and 25 Wilson's snipe a day; 8 woodcock a day, 125 a season. Migratory game birds legally taken during open season may be possessed until Mar. 31, and others during first 15 days of close season.

Export: Export of moose and deer, or parts thereof, prohibited, except nonresident licensee may take out game animals killed by himself, under customs declaration and approval of Canadian collector of customs; export of grouse or partridges and of migratory birds prohibited during close season. Big game lawfully taken and coming from without Province may be transported under permit issued by minister of colonization.

Sale: Sale of deer and moose or any part thereof, and of all migratory game birds (except ducks during the open season) prohibited; also spruce partridges until October 15, 1930. Other game lawfully taken may be sold from the third day of open season to and including the fifteenth day after expiration of open season. Licensed hotels, restaurants, and clubs may serve meat of hares, bears, ducks, and ptarmigan lawfully taken.

SASKATCHEWAN

Open seasons:[12]	*Dates inclusive*
Deer, moose (males only), caribou (see exception)	Nov. 15–Dec. 14.
Exception: South of Township 35	No open season.
Hungarian partridge	Oct. 1–Oct. 31.
Duck, goose, coot, Wilson's snipe or jacksnipe	Sept. 15–Dec. 31.

No open season: Antelope, buffalo, elk, and females of big game other than caribou, and young of big game under 1 year of age.[13] Sage grouse, prairie chickens, pinnated grouse, sharp-tailed grouse, ruffed grouse, partridges, Canada grouse, spruce grouse, ptarmigan, rail, swans, wood duck, bitterns, little brown, sand-hill, and whooping cranes, grebes, gulls, herons, loons, terns, and all shore birds (except Wilson's snipe or jacksnipe).

Hunting licenses: Nonresident alien: Big game, $50; birds, $25; nonresident domiciled in Canada: Big game, $25; birds, $10; issued by minister of railways, labor, and industries. Resident: Big game, $5; birds, $1.50; issued by minister or agent. Bird license not required of residents hunting on land outside city, town, village, or hamlet on which they are actually domiciled. No license issued to person under 16 without written consent of parent or guardian. Big-game hunters must wear white suit and cap. Hunting prohibited on inclosed lands without consent. Taxidermist, $5.

Bag limits and possession: One moose, 2 deer, 2 caribou, but not more than 2 in all of big game animals a season; 10 Hungarian partridges a day, 30 a season; 10 geese, 30 in all of waterfowl a day; 30 geese, 200 in all of waterfowl a season; 25 coots a day, 150 a season; 15 Wilson's snipe a day, 150 a season. Game birds may be kept in licensed storage from Sept. 16 to Mar. 1 and flesh of big game from Dec. 1 to Apr. 1 if tagged with number and kind of game, name of depositor, and number of his hunting license. Licensed hunters must report number of big game and game birds killed.

Export: Export of all protected game prohibited; provided, nonresident licensee on leaving Province may take with him during open season personally under his license coupons and permit big game and 100 game birds legally killed. Export of migratory birds prohibited during close season. Minister may issue permits to export deer (fee $2 a head) or other big game (fee, $5 a head), hides of big game (fee, $1 each), flesh of big game (fee, $1 each 20 pounds or less); birds (fee, $1 a dozen; limits, 5 dozen waterfowl a season). No permit may be issued for the entire carcass of a moose, caribou, or other deer, and no person may export in one season more than 60 ducks or geese.

Sale: Sale of migratory game birds and flesh of all other protected game prohibited.

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[12] *Saskatchewan:* Lieutenant governor in council may extend close seasons over current year, within limits, on petition of six game guardians.

[13] Male moose having horns less than 6 inches in length deemed to be under 1 year of age.

YUKON

Open seasons:[14]	*Dates inclusive*
Deer, moose, caribou, mountain sheep, mountain goat (males only)	Aug. 1–Mar. 1.
Partridge, prairie chicken, grouse, ptarmigan, pheasant	Sept. 1–Mar. 15.
Duck, goose, brant, rail, coot, gallinule, Wilson's snipe or jacksnipe	Sept. 1–Dec. 14.

No open season: Moose or caribou under 1 year of age; elk or wapiti, musk-oxen, bison or buffalo, and females of other big game; swans, cranes, grebes, gulls, jaegers, loons, terns, and all shore birds (except Wilson's snipe or jacksnipe).

Hunting licenses: Nonresident, $100 (permits the killing of 1 moose, 2 deer, 2 caribou, 1 mountain sheep, and 1 mountain goat); licensee in addition may kill 1 moose, 2 deer, 2 caribou, 1 mountain sheep, and 1 mountain goat, but must pay a fee of $25 for each additional animal so taken. Resident, $25 (special license authorizing the killing of male moose and male caribou over 1 year of age at any time for food supplies in the Territory); licensee must make annual returns. Resident: Chief guide, $20; assistant guide, $10. Issued by commissioner or game guardian.

Bag limits and possession: (For limits on big game to a nonresident, see "Hunting licenses.") Six caribou, 6 deer, 2 moose, 2 mountain sheep, 2 mountain goats, 6 bears a season; 25 ducks, 15 geese, 15 brant, 25 in all of rails, coots, and gallinules, and 25 Wilson's snipe a day. Migratory game birds legally taken during open season may be possessed until Apr. 14.

Export: Export of migratory birds prohibited during close season. Upon affidavit of lawful killing, commissioner may issue permit to export game. Export of raw hide of moose or caribou prohibited except under permit. Trophies, including head, hide, and hoofs, of big game lawfully killed by nonresident may be exported under his license and certificate of game guardian.

Sale: Deer, moose, caribou, mountain sheep, and mountain goats lawfully taken may be sold during the open season and 60 days thereafter. Male moose and male caribou more than 1 year of age killed by a resident under special license may be sold at any time for food upon obtaining certificate of lawful killing from a game guardian. License (fee, $10) required to purchase and traffic in flesh of moose or caribou. Licensee must make annual returns. Sale of migratory birds prohibited during close season.

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[14] *Yukon:* Indians, explorers, surveyors, prospectors, miners, and travelers in need of food may take game during close season. Commissioner in council may alter seasons.

COLONY OF NEWFOUNDLAND

Open seasons:	*Dates inclusive*
Hare, rabbit	Oct. 1–Dec. 20.[15]
Ptarmigan, willow grouse or partridge, goose, plover, curlew, snipe, or "other wild or migratory birds (except crows and hawks, unprotected)"	Oct. 1–Dec. 20.[15]

No open season: Elk, moose, caribou, capercailzie or black game.

Fishing licenses: Nonresident: Fish (salmon and sea trout), season, $26; 14-day license, $10.50; 4-day license, $2.40. Guide, nonresident, $50; resident free. Issued by game and inland fisheries board.

Unlicensed guides not to be employed. Guide may not conduct party of more than three.

Export: Export for sale prohibited of partridge, willow or other grouse.

Sale: Ptarmigan and willow grouse may be sold Oct. 10–Jan. 1; other birds may be sold during open season; rabbits, Oct. 10–Mar. 15.

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[15] *Newfoundland:* Hare or rabbit may also be taken with trap or snare until Mar. 1. Unlawful to possess hares or rabbits, ptarmigan or grouse in storage, Oct. 1 to Oct. 10.

MEXICO

Open seasons:[16]	*Dates inclusive*
Upland plover	Sept. 1–Sept. 30.
Wilson's snipe or jacksnipe, duck, goose, swan	Nov. 1–Feb. 28.
Other shorebirds	Aug. 16–Sept. 30.
White-winged dove	Sept. 16–Nov. 30.
Pigeons and other doves	Oct. 1–Dec. 31.
Wild turkey, curassow, cojolite	Sept. 1–Dec. 31.
Rabbit	Sept. 1–Feb. 28.
Deer, male, northern region, central tablelands (and similar places more than 1,000 meters above sea level)	Oct. 16–Jan. 31.
Deer, male, northwest region (Lower California, Sonora, and Sinaloa)	Sept. 16–Dec. 31.
Deer, male, south of Tropic of Cancer	July 1–Sept. 30.
Bear	Sept. 1–Oct. 31.

Open seasons—Continued.	*Dates inclusive*
Peccary	Aug. 1–Feb. 28.
Alligator	Sept. 16–May 31.
Anteater, kinkajou	Oct. 1–Jan. 31.
Paca, armadillo	Nov. 1–Jan. 31.
Tapir	Sept. 1–Nov. 30.

No open season: Antelope, mountain sheep (1932). White heron (1931). Mule deer on Cedros Island (1933). Gulls, insectivorous and song birds, manatees, and the young and females of all animals.

Licenses:[16] Hunting for sport: Nonresident alien: Municipality (10 days), $3.30; 30 days, $8.80. State (30 days), $11; 60 days, $16.50. Countrn (6 months), $22; 1 year, $44. Resident citizey or resident alien: Municipality (10 days), $1.10; 1 year, $5.50; State (6 months), $5.50, 1 year, $11; Country, (6 months), $11; 1 year, $22. Licenses and permits also required for professional and commercial hunting and for the utilization of game products.

Export: Export of live game birds or animals prohibited except under special permit to a limited number of concessionaires. Fees vary for different species.

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[16] *Mexico:* Secretaria de Agricultura y Fomento, City of Mexico, has authority to establish seasons and issue licenses.

IMPORTED GAME AND GAME RAISED IN CAPTIVITY

The Department of Agriculture, acting in conjunction with State game officials and sportsmen, aids so far as possible in establishing the game-breeding industry by preparing drafts of suitable laws to be enacted by the States, issuing permits to breeders to obtain wild migratory waterfowl and their eggs, and otherwise advising where stock may be obtained. The department does not distribute breeding stock or eggs, but in proper cases and under suitable restrictions issues permits to assist legitimate enterprises in the conduct of the business of game farming. The possession, sale, and transportation of imported game and game raised in captivity is also regulated in most States by State laws, which are covered in the following summary:

Federal regulations:[17] Under permit from the Secretary of Agriculture, and subject to the provisions of State laws, live migratory waterfowl raised in captivity may be possessed, sold, and transported at any time for propagation, and such birds may be killed in any manner (except that they may be killed by shooting only during the open season for waterfowl in the State where killed) and carcasses with heads and feet attached may be sold and transported at any time to any person for actual consumption, or to the keeper of a hotel, restaurant, or boarding house, retail dealer in meat or game, or a club, for sale or service to their patrons who may possess such carcasses for actual consumption without a Federal permit; provided that no migratory waterfowl killed by shooting shall be bought or sold unless each bird before attaining the age of 4 weeks shall have had removed from the web of one foot a portion thereof in the form of a V for identification purposes.

Permits also are issued under proper restrictions and subject to State laws for capturing a reasonable number of wild migratory waterfowl and taking their eggs to enable persons desiring to engage in the business to acquire the nucleus of a breeding stock or to improve the strain of birds on hand, but such wild birds may be sold and possessed only for propagation and may not be killed or sold for food.

Alabama: Commissioner of game and fisheries may issue a permit (fee, $1) to capture or export not more than 10 pairs of each species of game or birds for propagating purposes.

Alaska: Under permit from Secretary of Agriculture wild animals, ducks, geese, and nonmigratory birds may be taken, possessed, and transported for propagation.

Arizona: State game warden may issue permit to take, export, or import game or birds for propagating purposes; and may also issue permit to retain in captivity not more than four abandoned young of big game which applicant has rescued.

Arkansas: Permit (fee, $2) required to propagate game in captivity.

California: Game raised in captivity under breeder's license (fee, $2.50) may be sold for breeding purposes, and under regulations of commission may be sold for food if tagged (fee, 3 cents a tag). All game raised in captivity (except deer) must be killed otherwise than by shooting. Permits may also be issued to capture, possess, or transport wild game animals and game birds for propagating purposes. Shipments by parcel post are prohibited. Pheasants and domesticated reindeer may be imported and sold under regulations of commission.

Colorado: Game raised in licensed private parks, if accompanied by an invoice, and game (except migratory birds other than migratory waterfowl raised in captivity in conformity with Federal regulation—No. 8) brought into State by licensed importer, if shipping invoice is indorsed to purchaser, may be sold and transported. Commissioner may issue permit to capture or import game for propagating purposes.

Connecticut: Game birds and quadrupeds raised in preserve under license (fee, $2) may be sold and transported, if tagged, under regulations of commissioners of fisheries and game. Game legally taken and transported from another State or country that does not prohibit its sale or export may be sold under regulations of the board. Permit required to import game protected in the State.

Delaware: Pheasants and Hungarian partridges may be possessed and sold for propagating purposes. Board, by permit (fee, $1), may authorize any person to capture, possess, and transport not more than 10 pairs of each species of game or birds for propagating purposes.

District of Columbia: Hungarian partridges, English, Mongolian, Chinese, and ring-necked pheasants, and migratory waterfowl raised in captivity, in conformity with Federal regulations, may be possessed, sold, and transported.

Florida: Game-farming license (fee, $5) must be obtained from State game commissioner. Game and birds may be taken for propagation under permit of commissioner.

Georgia: Registered breeder may possess, buy, sell, and transport game for propagation.

Idaho: Permit of State game warden required to take or keep waterfowl in captivity for decoy purposes. Under regulations of the State game warden, game may be propagated in private parks.

Illinois: Game raised in captivity under a breeder's license (fee, $5), may be possessed, sold, and transported for food or propagating purposes.

Indiana: Birds and animals raised in captivity may be kept, killed, sold, or transported under certificate of inspection (fee, $5) from the conservation commission, and game birds legally acquired may be possessed for breeding purposes under like certificates.

Iowa: Game birds raised in captivity under license (fee, $2) may be sold for food or propagating purposes.

Kansas: Game raised in captivity under permit (fee, $2) may be sold and transported, and, under permit and regulations of warden, wild animals and birds and eggs of birds may be taken for propagating purposes.

Kentucky: Game birds and game animals raised in captivity under permit may be sold and transported, but all carcasses must be tagged.

Louisiana: Game raised in captivity under license (fee, $10) may be sold and transported for food, stocking, or breeding purposes, but all carcasses must be tagged. Traffic prohibited in birds killed by shooting. Wild birds or mammals may be brought into State for liberation, and game may be exported for educational, scientific, or propagating purposes, under permit from commissioner.

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[17] See Federal regulation 8 for full details and requirements (footnote 1, p. 5).

Maine: Game raised in captivity under breeder's license (fee, $10) may be killed, sold, and transported under regulations of commissioner, and live game may be captured or exported for breeding and advertising purposes, under regulations and permit of commissioner.

Maryland: Game raised in captivity under breeder's license (fee, $5) may be sold and transported under permit and tag of State warden. Such game must be offered to State warden before being offered for sale elsewhere. Chinese, English, Mongolian, or ring-necked pheasants raised in captivity may be killed by shooting or otherwise from November 10 to December 31 on premises where raised.

Massachusetts: Under regulations of division of fisheries and game, deer, elk, pheasants, quail, and European or gray partridges raised in captivity under license (no fee), may be sold for propagation, and killed and sold for food purposes, if tagged; and licensed dealers may sell unplucked bodies of pheasants, Scotch grouse, European black game, European or gray partridges, red-legged partridges, and Egyptian or migratory quail imported from without the United States, if tagged, and deer, moose, caribou, and elk lawfully killed and coming from without State, if tagged by warden of State or country where procured. State tag fees, 5 cents each. Hares and rabbits may be sold during the open season if secured and imported from a country where their sale is not prohibited. Waterfowl may be reared in captivity and sold under Federal regulations (No. 8).[17]

Michigan: Game animals or birds raised in captivity under license (fee, $5 to $50) may be sold and transported for food, breeding, or stocking purposes. Carcasses of such game must be tagged (tags, 5 cents each). Licensed dealer, club, hotel, restaurant, or boarding house (fee, $5) may sell or serve imported game or game raised in captivity, if tagged, to patron or customer for actual consumption or use.

Minnesota: Game (except deer and Hungarian partridges) raised in captivity under license (fee, $3, and 15 cents additional for each acre over 10 acres) may be sold alive for propagating purposes, and may be killed, sold, and transported under regulations of commissioner. Under regulations of the commissioner, wild animals and birds and eggs of birds may be taken for propagation.

Mississippi: Licensed owner or operator of game preserve may buy, sell, or transport within or out of the State for propagating purposes game raised on such preserve, but no game may be shipped out of State except during open season thereon.

Missouri: Deer, elk, and other protected game raised in captivity under license (fee, $5) may be transported and sold under regulations of commissioner. Export (except of quail) for propagating purposes allowed under permit.

Montana: Game raised in private preserves under license (fee, $5) may be killed, sold, and transported. Commission may authorize capture under permit of wild animals and birds for propagation.

Nebraska: Game animals and birds may be raised in captivity for profit under license (fee, $1 to $10, according to number of birds or animals, 25 to 50 or more, and regulations of commission, or for nonprofit purposes, fee $1) may be sold for propagation, and killed and sold for food purposes if tagged. Keeper of hotel, boarding house, restaurant, club, or retail dealer in meats under license (fee, $5) may sell tagged game to patron or customer for actual consumption, but tags must remain on carcasses until consumed.

Nevada: Game raised under license (fee, $25) may be sold or shipped under invoice.

New Hampshire: Game raised in captivity under license (fee, $2) may be sold and transported, if tagged, under regulations of commissioner. Game (except ruffed grouse) imported from without the United States, if tagged and marked to show kind and number, name and address of consignor and consignee, initial point of billing, and destination, may be exported unaccompanied by owner.

New Jersey: Mallard, wood, and black ducks, Canada geese,[17] English and Mongolian pheasants, quail, ruffed grouse, deer, rabbits, raccoons, and squirrels raised in preserves under license (fee, $5) may be possessed and sold for propagation, and may be sold for food or exported for sale if tagged (tag fee, 5 cents). Unplucked carcasses of Scotch grouse, European black grouse, European black plover, red-legged partridges, and Egyptian quail coming from a foreign country, if tagged by State authorities, may be sold for food purposes.

New Mexico: Game may be raised in licensed preserve. State warden may issue permit (fee, $1.25) to retain in captivity not more than 4 abandoned young of big game that applicant has rescued. Holder of a hunting license, under permit from State warden, may capture and export game or birds for propagating purposes. Game (except migratory birds other than waterfowl raised in captivity in conformity with Federal regulations [17]) coming from without State may be possessed and sold by a hotel, restaurant, café, boarding house, or dealer under a permit good for not more than 30 days.

New York: Elk, mule deer, white-tailed deer, European red deer, fallow deer, Japanese deer, roebuck, pheasants, bobwhite, quail, Hungarian or gray-legged partridges, Canada and Hutchins's geese, and mallard and black ducks raised in captivity under license may be sold for breeding purposes; carcasses of quail or Hungarian or gray-legged partridges may not be sold for food nor may those killed by shooting be bought, sold, or trafficked in, but all other species mentioned may be killed, shipped, and sold or exported for food, if tagged. Such ducks and geese may be killed by shooting during the open season but when so killed may not be sold unless marked and tagged as required by conservation department.[17] Varying hares and cottontail rabbits raised in captivity under license (fee, $5) if tagged, may be sold for food purposes during close season, under regulations of department.

Licensed breeders in States having laws similar to the game-breeding law of New York may, under license (fee, $5) and cost of inspection, ship into State domesticated American elk, white-tailed deer, European red deer, fallow deer, roebuck, pheasants, Canada and Hutchins's geese, and mallard and black ducks, which, if tagged, may be sold under regulations of department.

License to possess and sell birds and quadrupeds for propagation, scientific, educational, or exhibition purposes, fee, $1.

Unplucked carcasses of tinamou, pheasants, Scotch grouse, European gray-legged partridges, Norwegian ptarmigan, Norwegian grouse, and Egyptian quail, and species or subspecies not native to State, and carcasses of European red deer, fallow deer, and roebuck imported from without the United States may be sold under license if tagged. No restrictions on reindeer.

North Carolina: Game may be raised in domestication under regulations of department of conservation and development, and may be taken for propagation under permit (fee, $1).

North Dakota: Game may be kept in captivity under permit of board.

Ohio: Ring-necked, Mongolian, or Chinese pheasants and mallard and black ducks raised in captivity under a breeder's license (fee, $5) may be sold and transported for food or propagating purposes; carcasses of such birds must be tagged. No pheasant, mallard, or black duck raised in captivity may be killed by shooting except during the open season, and no mallard or black duck killed by shooting may be bought or sold unless it shall have had a well-defined V-shaped section removed from the web of one foot before attaining the age of four weeks.

Deer, squirrels, and rabbits legally taken or acquired may be possessed in inclosures as pets.

Oklahoma: Game raised under license (fee, $2) may be sold and transported for propagation and for food, if tagged, during season prescribed by

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[17] See Federal regulation 8 for full details and requirements (footnote 1, p. 5).

[17] See Federal regulation 8 for full details and requirements (footnote 1, p. 5).

commission. Wild animals or birds may not be taken in State for breeding purposes.

Oregon: Game birds and animals raised in captivity under permit (fee, $2) may be exported or sold for propagating, restocking, or food purposes; carcasses must be tagged (fee, 5 cents). Written permit from State warden, showing kind of game and names and addresses of consignor and consignee, must be attached to each shipment.

Game animals and birds coming from without the United States and game taken in a State where it may be sold, may be sold and transported under permit and tag of State warden, but the only migratory birds that may be sold are waterfowl reared in captivity under Federal[17] or Canadian regulations.

Pennsylvania: Game breeder's certificate required, fee, $1; bond, $500. Game raised in captivity may be sold or transported within State; or, under permit, out of State.

Rhode Island: Game raised in captivity under permit may be sold for propagation, under regulations of commissioners. Game lawfully killed and exported may be brought into State under permit, but such game may not be sold.

South Carolina: Birds and animals legally taken may be kept in possession for propagating purposes. The Federal regulations have been adopted as the State law with respect to migratory birds.[18]

South Dakota: Game raised in captivity under license may be exported or sold under written permission of State game warden.

Tennessee: Under permit (fee, $1) of State warden 10 pairs of game animals or birds may be taken for propagation. Special law in Rutherford County.

Texas: Game animals and birds may be captured or imported for propagating purposes under permit of commissioner.

Utah: Game raised in private preserve under permit (no fee) of commissioner may be sold and transported, if tagged.

Vermont: Game raised in licensed private preserve (fee, $2) may be sold or exported for food or propagating purposes. Carcasses must be tagged.

Virginia: Game animals and birds raised under breeder's license (fee, $25) may be disposed of for propagating or other purposes. Carcasses of game raised in captivity must be tagged (fees, wild turkeys, 10 cents; deer, bear, or elk, 50 cents; other birds and animals, 2 cents each). Proprietor of hotel or restaurant or dealer in game under a license (fee, $5) may sell to guests or patrons deer, wild turkeys, quail, ruffed grouse, and waterfowl raised in captivity and may sell domesticated rabbits without a license.

Licensed game breeder, under permit and regulations of commission, may trap wild animals or birds for breeding purposes, but animals or birds so taken shall not be sold or otherwise disposed of. Game breeder's license issued only to residents of State.

Washington: Game animals and birds raised in captivity under license (fee, $20, renewal, $10 annually) may be sold and transported at any time, or sold for food, if tagged. Keeper of hotel, restaurant, boarding house, or club, and retail dealer in meats may sell game raised under game farmer's license, if tagged. Under permit from supervisor of game and game fish wild animals and birds may be imported from without State for propagating purposes.

Game animals and birds coming from without State, if reported within three days and tagged (fee, 25 cents a tag), may be possessed for tanning, mounting, manufacturing, or ornamental purposes and disposed of in usual course of trade, but the only migratory birds that may be sold are waterfowl reared in domestication under Federal and Canadian regulations.[17]

West Virginia: The owner may kill elk or deer kept in inclosure and may pursue and recapture, by killing or otherwise, elk that have escaped from his inclosure. Game and fur animals, game birds, fish, and frogs may be taken under permit (fee, $1) for propagation.

Wisconsin: Under permit and supervision of commission wild animals and birds may be taken and transported for propagation within State. Park boards allowed to ship, under permit of State conservation commissioner, live animals and game birds for park purposes.

Wyoming: Under permit (fee, $5) and supervision of commission, game animals may be taken for propagation. Animals so taken may not be killed, sold, or disposed of for three years, but their natural increase may be sold, transported, and disposed of. Exchange of game animals andf birds for liberation in State allowed under permit of State game commission.

Canadian regulations:[18] The Canadian regulations, administered by the commissioner of national parks of Canada, Ottawa, are similar to the provisions of the Federal regulations in respect to propagation of migratory waterfowl, but apply to all migratory birds protected by the treaty; and all birds raised in captivity and intended for food purposes must be killed otherwise than by shooting, and each of such birds before it can be sold must bear a metal tag, which may not be removed from carcass. Under section 5 of the Canadian customs export act (R. S. C., 1906, ch. 50) a person may export carcass or parts thereof of a deer raised on his own land or on lands owned by a company or association o which he is a member, upon his making affidavit on face of export entry that the carcass, or parts thereof, is of a deer so raised.

Alberta: Minister of agriculture may authorize persons to possess, buy, sell, and export big game and game birds raised in captivity, and to capture big game and game birds for propagation. Permit fees fixed by lieutenant governor in council.

British Columbia: Game commissioner may authorize persons to possess, buy, sell, and export game animals and game birds raised in captivity, and to capture game animals and birds and collect eggs of birds for propagation. Permit required to import live animals or birds into the Province; permit fees fixed by lieutenant governor in council.

New Brunswick: Minister of lands and mines may authorize persons to possess, buy, sell, and export game raised in captivity, and to capture game for propagation. Permit fees fixed by minister.

Northwest Territories: Minister of the interior may authorize persons to possess, buy, sell, and export wild mammals and birds raised in captivity, and to capture wild mammals and birds and collect eggs of birds for propagation.

Nova Scotia: Minister may authorize persons to possess, buy, sell, and export wild mammals and birds raised in captivity, and to capture wild mammals and birds for propagation.

Ontario: Minister of game and fisheries may authorize persons to possess, buy, sell, and export game animals and birds raised in captivity, and to capture game animals and birds for propagation during close season. Imported game may be sold or exported under license.

Prince Edward Island: Domesticated wild geese and brant in captivity are deemed personal property of owner, and may be possessed, disposed of, and transported without reference to the provisions of the provincial game act. Waterfowl and other migratory birds, however, are subject to the provisions of the migratory birds convention act and regulations.[18]

Quebec: Minister may authorize game animals and birds lawfully taken during the open season to be retained in captivity.

Saskatchewan: Minister of railways, labor, and industries may authorize persons to possess, buy, sell, and export big game and game birds raised in captivity, and to capture big game and game birds for propagation. All shipments must be tagged. Permit and tag fees fixed by minister.

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[17] See Federal regulation 8 for full details and requirements (footnote 1, p. 5).

[18] See Canadian regulation 13 (footnote 1, p. 5).

Yukon: Gold commissioner may authorize persons to possess, buy, sell, and export game animals (except buffalo or bison) and birds raised in captivity, and to capture such animals and birds for propagation.

Newfoundland: Game and inland fisheries board may authorize persons to capture, possess, buy, sell, and export caribou for propagation. Eggs of wild geese may be taken until May 15 for propagation only.

FIELD SERVICE, DIVISION OF GAME AND BIRD CONSERVATION BUREAU OF BIOLOGICAL SURVEY

[Violations of Federal game laws may be reported to the nearest official listed, or to the Chief, Bureau of Biological Survey, United States Department of Agriculture, Washington, D. C.]

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SOYBEAN UTILIZATION

By W. J. Morse, *Senior Agronomist, Office of Forage Crops and Diseases, Bureau of Plant Industry*

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INTRODUCTION

THE WIDESPREAD INTEREST in the soybean, created by the phenomenal increase in acreage and production, indicates that the crop is destined to become one of considerable economic value in the United States. Within a decade it has advanced from a position of minor to one of major importance. Whereas previously it was grown occasionally, usually as a substitute crop when clover or some other crop had failed, at the present time the soybean occupies a permanent place in many of the rotations of the farming systems of the eastern half of the United States. With its wide range of uses and numerous varieties, its production is no longer localized and its increasing importance is assured. The soybean is the most important legume grown in Asiatic countries in the scope of its utilization and value. It is grown primarily for the beans, which are used to a very large extent in the manufacture of numerous products for human food. The beans are also extensively utilized, especially in Manchuria, in the production of oil and meal.

The soybean is used in the United States primarily for forage purposes, being preserved either as hay or silage or cut and fed green as silage, and it is also pastured extensively with hogs and sheep. Occasionally it is used as a green manure or summer cover crop in orchards. Although it will no doubt continue to grow in use as a forage crop, indications are that the future increase in acreage will be largely for the production of beans.

Unlike the seed of most other legumes, that of the soybean is rich in oil, which makes the crop an important source of vegetable oil and meal. Several mills in the Mid-Western and Southern States are now crushing domestic-grown beans for oil and meal, and other mills are being built or equipped for this purpose.

The value of the soybean and its products, and their industrial uses, together with methods of converting soybeans into proper form for such uses, are being extensively studied. The commercial possibilities of the soybean and its products offer a potential outlet for a supply of beans many times the present surplus above seeding requirements. The extent of commercial utilization seems to be limited chiefly by the supply of the raw product.

The following outline shows the manifold uses to which the soybean may be put. Few other plants are useful in so many ways.

- Soybean
  - Plants
    - Green manure.
    - Forage
      - Hay.
      - Silage.
      - Soiling.
    - Pasture.
  - Beans
    - Meal
      - Celluloid substitute.
      - Stock feed.
      - Fertilizer.
      - Human food
        - Breakfast foods.
        - Diabetic foods.
        - Flour
          - Breads.
          - Cakes.
          - Pastry.
        - Infant foods.
        - Macaroni.
        - Crackers.
        - Soy milk.
        - Bean curd.
        - Soy sauce.
        - Bean powder.
      - Glue.
      - Vegetable casein.
      - Water paints.
    - Oil
      - Glycerin.
      - Enamels.
      - Food products
        - Butter substitutes.
        - Lard substitutes.
        - Edible oils.
        - Salad oils.
      - Varnish.
      - Waterproof goods.
      - Linoleum.
      - Paints.
      - Soap stock
        - Hard soaps.
        - Soft soaps.
      - Celluloid.
      - Rubber substitutes.
      - Printing inks.
      - Lighting.
      - Lubricating.
      - Core binder.
      - Candles.
      - Lecithin.
    - Green beans
      - Green vegetable.
      - Canned.
      - Salads.
    - Dried beans
      - Stock feed
        - Sheep.
        - Hogs.
        - Cattle.
        - Poultry.
      - Soy sauce.
      - Boiled beans.
      - Baked beans.
      - Soups.
      - Coffee substitute.
      - Vegetable milk
        - Bean curd
          - Fresh.
          - Dried.
          - Smoked.
          - Fermented.
        - Condensed soy milk.
        - Fresh soy milk.
        - Confections.
        - Soy casein
          - Paper size.
          - Paints.
          - Textile dressing.
          - Waterproofing for textiles.
        - Soy-milk powder.
      - Breakfast foods.

SOYBEANS FOR HUMAN FOOD

The soybean has been utilized for many centuries by the people of oriental countries in the preparation of numerous fresh, fermented, and dried food products which form an indispensable part of their diet. The various soybean food products not only give flavor and relish but furnish to a very considerable extent the protein that in the diet of the western people is supplied largely by meats. Some of these preparations are eaten by oriental people at every meal and by rich and poor alike. Shoyu or soy sauce is the only one of these oriental products that has been introduced to any extent into other countries.

The importance of legumes is becoming more generally recognized as an economical source of protein. In view of the richness in nutrient constituents, the extent to which these are assimilated by the body, and the numerous products to be prepared, the soybean deserves high rank as an important food material. Investigations of the nutritive efficiency of the soybean have shown that it contains both the water-soluble and the fat-soluble vitamins. It contains at the most but a slight trace of starch. Extensive experiments in North America and Europe indicate its value as the basis of food for persons requiring a low starch diet, and for many years food companies have had on the market forms of soybean flour prepared for persons requiring a diet of this kind. Extended investigations show that soybean flour as a gruel is a most valuable food in the dietary of infants.

In North America the soybean has attracted attention at various times as an article of food, but thus far it has been little used. Attempts have been made at various times to use it in the manner of field and navy beans, but with little success. Several food manufacturers have recently begun the manufacture of different foodstuffs such as soy sauce, soybean flour, breakfast foods, and edible oil, from the soybean and its products, oil and meal. Undoubtedly some of the soybean products of the Orient may meet with increasing favor in North America, but prejudice and custom are among the factors that prevent a people from quickly adopting new foodstuffs.

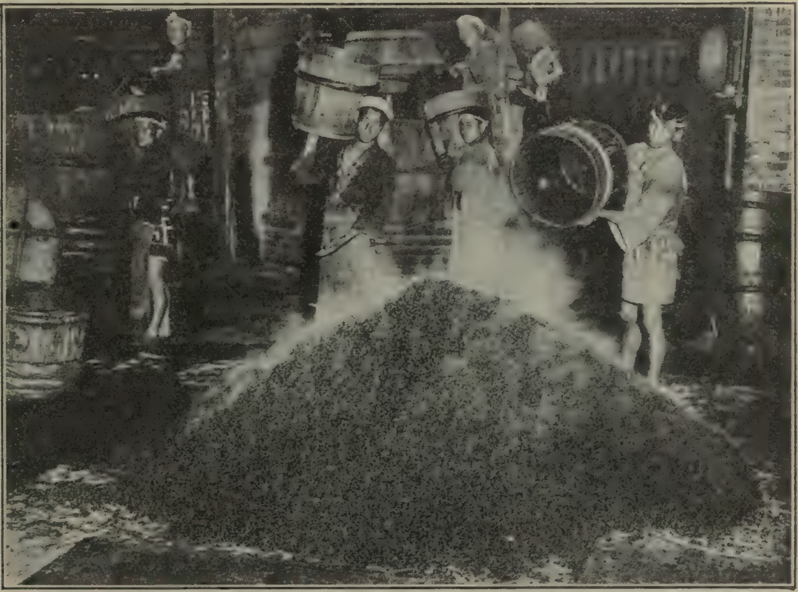

FIGURE 1.—Steamed soybeans in the preparation of miso, a popular Japanese food

DRIED BEANS

The mature or dried beans of the yellow-seeded varieties may be used after the manner of navy or other beans in making numerous palatable and nutritious dishes. Because of their high fat content and compact texture, most varieties of soybeans do not cook so readily as the navy or field bean. The Easycook and Hahto varieties, however, cook fully as soft as other beans. In China and Japan the dried or mature soybean is seldom used for boiling or baking but is an ingredient in numerous fermented products such as miso and natto (fig. 1). When properly roasted and prepared, the soybean makes an excellent cereal beverage, and it has been used at various times in the United States as a coffee substitute. It was at one time sold as "coffee bean." In oriental countries soybean coffee substitute is a commercial product. In China the beans are soaked in salt water and then roasted, the product being eaten after the manner of salted peanuts.

GREEN OR VEGETABLE BEANS

When soybeans are about fully developed the beans make a most palatable and nutritious green vegetable, being used in the same manner as the green pea or the Lima bean. The pods are tough and not desirable, but if boiled from 5 to 10 minutes the shelling of the beans will be facilitated. The Hahto and Easycook varieties have been found especially valuable for use as green beans.

SOYBEAN FLOUR

Soybean flour is made by grinding either the whole bean, preferably yellow-seeded varieties, or the press cake after the oil has been removed from the beans. In invalid and infant dietetics soybean flour has been used for many years in the United States, although as yet it is not a common commercial product. Extensive tests show that the flour can be successfully used in the making of bread, muffins, biscuits, crackers, and gems. (Fig. 2.) About one-fourth soybean flour and three-fourths wheat flour is the proper proportion. This addition of soybean flour gives a more nutritious article of food with a rich nutlike flavor. In some of the pastry products as much as one-half soybean flour can be used. When a special food of low starch content is desired, as for diabetic persons, a larger proportion of soybean flour is used with some form of gluten substituted for the wheat flour. On account of its high food value, as well as the palatable products made from it, soybean flour is finding increasing favor as a foodstuff in North America and Europe.

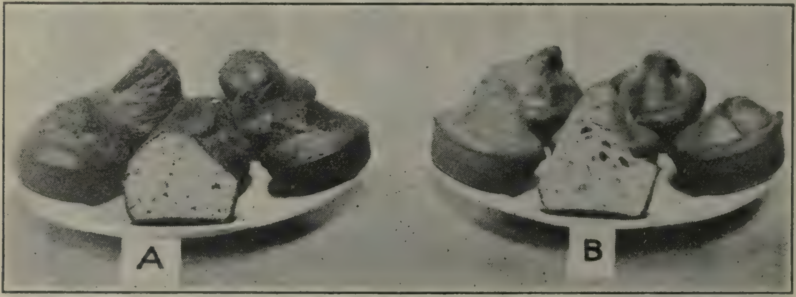

FIGURE 2.—Muffins made from equal parts of soybean and wheat flour (A) and from wheat flour (B). Soybean flour may be successfully used as a constitutent for bread and muffins with about one-fourth soybean flour and three-fourths wheat flour as the proper proportions

SOYBEAN OIL

One of the principal uses of soybean oil in the Orient, chiefly in China, is for food. It is consumed largely in the crude state by the poorer classes, but among the rich it is boiled and allowed to stand until clarified. Experiments show that soybean oil compares very favorably with the more common culinary table oils with respect to the thoroughness with which it is assimilated. After refining and deodorizing, it is used extensively in the production of salad and cooking oils and in the manufacture of lard and butter substitutes.

SOY SAUCE

Soy or shoyu sauce is a dark-brown liquid prepared from a mixture of cooked and ground soybeans, roasted and pulverized wheat (barley is sometimes used), salt, and water. This mass is inoculated with a culture known as rice ferment (*Aspergillus oryzae*) and left from 6 to 18 months in vats or casks (fig. 3) to ferment. Soy sauce is largely used by oriental peoples in cooking, as a relish or condiment to increase the flavor and palatability of the diet, and as an aid in the assimilation of food. One factory in the United States manufactures soy sauce from domestic-grown beans and has found a large commercial outlet throughout the country.

SOYBEAN SPROUTS

Soybeans and several other species of beans are sprouted and used as a green vegetable by the Chinese. Sprouted soybeans may be used in various dishes as a home winter vegetable.

SOYBEAN VEGETABLE MILK

If the dried beans, preferably yellow-seeded varieties, are soaked for a few hours, then finally crushed (fig. 4) and boiled for about 30 minutes in the proportion of 3 parts of water to 1 part of mash, a milky emulsion is obtained which is very similar in appearance and properties to animal milk. This liquid, separated out by means of a very fine sieve or cloth strainer, is the soybean or vegetable milk used so extensively in China. Soybean meal after the oil is extracted or whole soybean meal may be utilized quite as well as the whole bean. In the absence of animal milk, soybean milk is used extensively in the fresh state and as the basis of various kinds of vegetable cheeses in oriental countries. Soybean milk in the form of a powder is a commercial product in some European countries, and in parts of the United States it has been used in special feeding cases. Attempts have been made to manufacture the milk powder on a commercial scale. The milk can be used successfully in numerous preparations, such as breads and cakes, in creaming vegetables, in milk chocolate, and in custards.

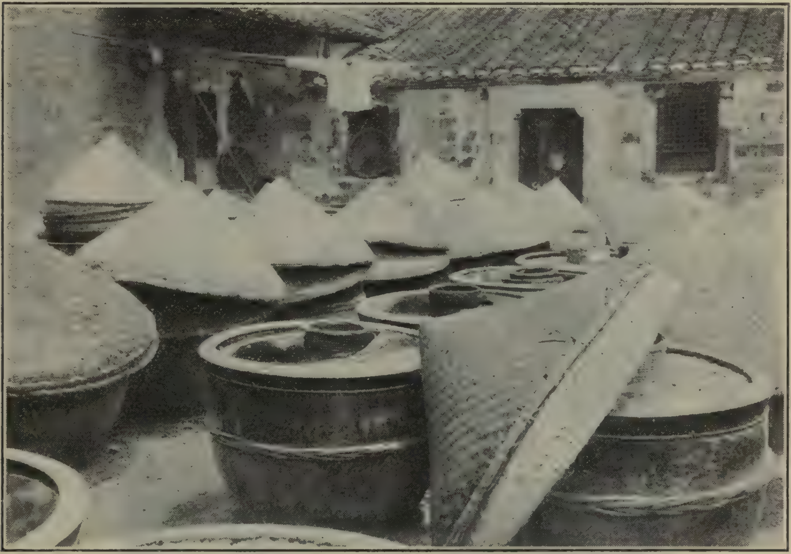

FIGURE 3.—Chinese courtyard with pots of fermented soybeans and brine from which the well-known soy sauce is made

After separating the liquid from the solid material, the residue is still very rich in nutritive substances and can be dried and used for cattle feed or made into flour for human food.

SOYBEAN CURD

The addition of magnesium or calcium salts or of rennet or lactic acid to soybean milk when hot precipitates some of the protein, forming a grayish white curd which settles out, leaving a yellowish watery liquid. This curd, after being drained and pressed, represents bean curd or tofu (fig. 5), which is extensively eaten and forms the basis of numerous fermented, smoked, and dried cheeses in China and Japan. Bean curd is made fresh daily and is a staple article of diet among oriental peoples. In many cities of the United States having a large oriental population fresh bean curd may be found in the Chinese and Japanese markets. Attempts to place canned bean curd on the market have met with but little success. Bean curd is a highly nutritious food and no doubt could be elaborated by the American housewife into a variety of palatable dishes.

SOYBEANS FOR LIVESTOCK

The efficiency of soybeans as a nitrogenous feed for all kinds of livestock is indicated by extensive feeding trials and practical experience. The beans can be used as a protein supplement to replace at least partially the expensive commercial protein concentrates necessary for stock feeding and milk production. The growing of soybeans will enable the farmer to produce at moderate cost at least part of these high-protein feeds.

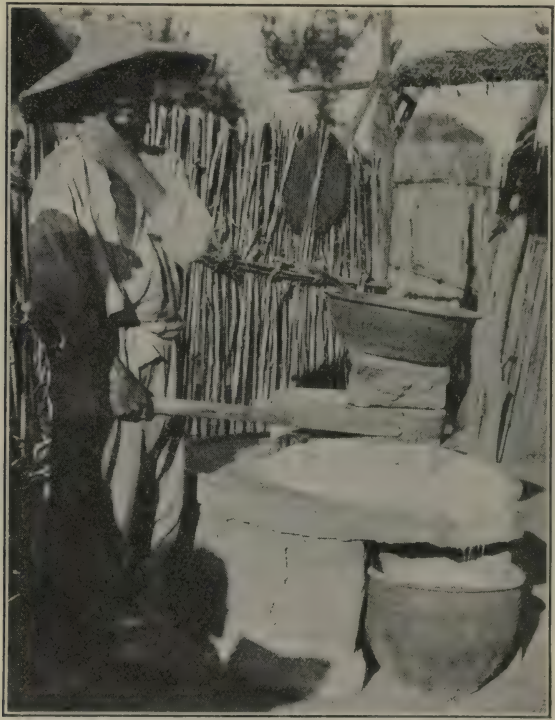

FIGURE 4.—Grinding soybeans with a stone mill in the manufacture of soybean milk in China

The beans contain from 30 to 46 per cent protein and thus compare favorably with other concentrated feeds. When fed to sheep and hogs, the beans can be fed whole, but in general it is preferable to crack or grind them. Practical experience has shown that it is advisable first to mix the beans with corn, oats, or peas and then grind them together into meal, as the soybeans are difficult to grind alone because of their high fat content. Owing to the high content of protein, soybeans should always be fed in mixture with a less concentrated feed. The amount of digestible nutrients in soybeans in comparison with other concentrated feeds is shown in Table 1.

TABLE 1.—*Analyses of soybeans and other concentrates*[1]

Feeding stuff	Moisture	Ash	Crude protein	Carbohydrates		Fat or ether extract	Digestible protein	Digestible carbohydrate equivalent[2]
				Crude fiber	Nitrogen-free extract			
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Soybeans (seed)	6.4	4.8	39.1	5.2	25.8	18.7	35.6	60.4
Cottonseed meal (choice)	7.1	5.7	41.7	10.0	28.4	7.1	35.0	40.7
Linseed meal (new process)	10.4	5.5	36.1	8.4	35.6	3.9	--------	--------
Wheat middlings	10.1	3.5	16.3	4.3	61.6	4.2	13.2	60.1
Wheat bran	9.6	5.9	16.2	8.5	55.6	4.2	12.5	48.7

[1] Analyses compiled by the Bureau of Chemistry and Soils.

[2] The carbohydrate equivalent shown is the sum of the digestible crude fiber and nitrogen-free extract, plus 2.25 times the digestible fat.

SOYBEANS FOR SWINE

Extensive feeding tests have shown the soybean to be one of the cheapest sources of protein grown on the farm for balancing a ration of corn for fattening hogs. As a supplement to corn meal for growing and fattening pigs, the Wisconsin Agricultural Experiment Station found that ground soybeans proved about 10 per cent superior to wheat middlings, figuring the cost of the feeds as the same. The Delaware station in a feeding test of the relative value of soybeans as protein supplements for fattening pigs found ground soybeans not so efficient as tankage for pork production, but the addition of bone meal considerably improved the efficiency of the soybeans. Experiments carried on at the Indiana station show that when a mineral mixture consisting of superphosphate (acid phosphate), wood ashes, and salt is combined with a ration of soybeans and corn, excellent and economical results in pork production are obtained.

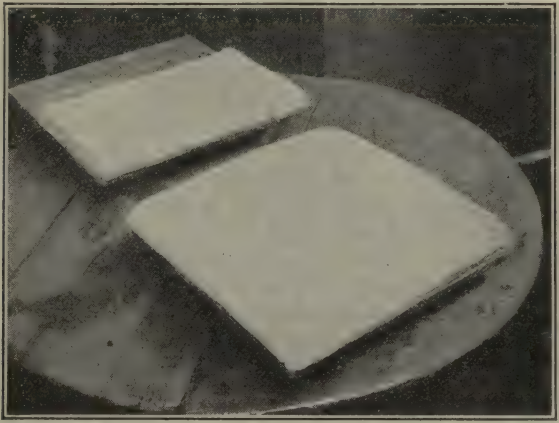

FIGURE 5.—Blocks of freshly made bean curd, "tofu," as sold in the markets in the Orient

Previous results from feeding soybeans with corn were unsatisfactory.

At the Ohio station experiments in which raw and cooked soybeans and soybean meal were compared with tankage as supplements to corn for fattening hogs showed that the corn and tankage rations gave slightly better results than the raw soybean ration without corn. However, when cooked soybeans were fed with minerals the gains exceeded those made by tankage. Other feeding tests were conducted in which fattening swine in dry lot had access to five varieties of soybeans together with corn and minerals. The different varieties of soybeans were kept in separate compartments of a self-feeder and the shoats had equal access to all varieties. The test showed that these varieties ranked in the following order of palatability: Midwest (yellow), Hamilton (brown), Manchu (yellow), Ebony (black), and Wilson (black).

SOYBEANS FOR DAIRY CATTLE

In feeding tests with dairy cows at the Iowa station, cracked soybeans proved to be worth $60 a ton when old-process linseed meal was worth $45 a ton for feeding milk cows. Soybeans were therefore a valuable supplement to a home-grown ration of corn silage, alfalfa hay, cracked corn, and ground oats. The soybeans were palatable and had no deleterious effects on the animals.

In comparing the relative value of ground soybeans and cottonseed meal for milk production, the Tennessee station found the two feeds to have about the same feeding value. The South Dakota station found ground soybeans 17.7 per cent more efficient than old-process linseed meal for butterfat and 19.9 per cent more efficient for milk production. Ground soybeans were found to be as palatable and gave as good physiological results as the linseed meal, and the flavor or odor of the milk was not affected. Ground soybeans do not noticeably affect the consistency of the butter until the grain ration contains 50 per cent or more soybeans.

At the Mississippi station ground soybeans produced 3.64 per cent less milk and 11.65 per cent more butterfat than an equal quantity of cottonseed meal. Ground soybeans were found to be slightly superior to soybean meal for milk and butterfat production. The Indiana station also found that ground soybeans gave better results than either soybean meal or linseed meal for milk production. In feeding tests conducted at the Delaware station in which soybean meal and ground soybeans were compared with peanut meal, the milk production proved about 2 per cent greater during the peanut-meal periods than during the ground soybean periods, indicating a very high feeding value for ground soybeans when used as a protein supplement in the dairy ration. A desirable effect of the ground soybeans in the ration was that the cows maintained their body weight much better during the ground soybean periods than during the peanut-meal periods. In fact the cows gained considerable weight during the periods of ground soybean feeding.

SOYBEANS FOR BEEF CATTLE

In feeding tests at the Indiana station, whole soybeans as a substitute for cottonseed meal gave satisfactory results with 2-year-old steers. The rate of gain was as rapid and the finish was as good. It was also found that the gains made by hogs following steers were materially influenced by the protein concentrate fed to the cattle.

SOYBEANS FOR SHEEP

In feeding trials with sheep at the Wisconsin station, soybeans produced larger gains and a heavier clip of wool than whole oats for a given amount of feed. Results indicate that soybeans are an economical supplement to corn for gains with sheep. At the Ohio station feeding tests indicate that for fattening lambs ground soybeans can be used to replace linseed meal as the protein concentrate in a ration of corn, alfalfa hay, and corn silage. As shown by the finish on the lambs and the profit per head, coarsely ground soybeans, after a grinding charge of 10 cents per hundred pounds was added, gave slightly more economical results than whole soybeans. The Indiana station found that soybeans may be used as a substitute for cottonseed meal in rations for fattening lambs. The average of three trials showed that gains made from the soybeans were made at as rapid a rate and at no greater expenditure of feed than when cottonseed meal was fed.

SOYBEANS FOR POULTRY

It has been demonstrated quite conclusively that soybean protein is a valuable nitrogenous food and may be used to good advantage in poultry rations. When used for poultry it is necessary, however, that the soybean ration be supplemented with a suitable mineral mixture. Many farmers have found that after soaking or cooking the whole beans are more readily eaten by poultry. At the Indiana station ground whole soybeans were found as satisfactory as soybean meal when used in place of tankage in a laying mash, provided a mineral mixture was added.

SOYBEANS FOR OIL

In addition to their forage and food value, soybeans contain a valuable oil which is utilized to a very considerable extent in Asiatic countries, in Europe, and in North America. In Manchuria the soybean is largely grown for oil (fig. 6) and meal and is always relied upon by the Manchurian farmer as a cash crop. It constitutes a staple product of Manchurian agriculture and occupies about 25 per cent of the total cultivated land. Previous to the Russian-Japanese war, China and Japan were not only the greatest producers, but were also the greatest consumers of the soybean and its products. About 1908 the first successful importations of soybeans from Manchuria were received in Europe and North America. The beans were utilized by extracting the oil, which was found valuable for various industrial purposes, leaving the bean cake or meal as a stock feed. As the value of the oil and meal became recognized, new uses and markets were found and the trade in the soybean and its products became one of great importance, until now it has assumed such large proportions that the soybean has become an important competitor of other oil seeds.

The first extensive use of the soybean in the United States for oil was about 1910, when an oil mill on the Pacific coast used beans imported from Manchuria. Although many efforts have been made during the past 20 years to interest cottonseed-oil mills of the Southern States in the utilization of domestic-grown soybeans for oil, no extensive work was done until the latter part of 1915. A shortage of cottonseed in the South at that time and a surplus of soybean seed in North Carolina led several cottonseed-oil mills in that State to enter upon an extensive production of soybean oil and meal. Increased interest in the use of the soybean for livestock and human food at that time brought about a large demand for seed and consequent high prices, which made the crushing of domestic soybeans unprofitable. As a result, during the following two or three years soybeans were imported from Manchuria and crushed by several southern cottonseed-oil mills. Since about 1923 soybean production, especially of the more generally grown varieties, has increased to such an extent that a saturation point has been reached in the supply of seed required for planting. Several soybean-oil plants have been built in the Middle Western States, and a few cottonseed-oil mills in the South are again crushing domestic-grown soybeans.

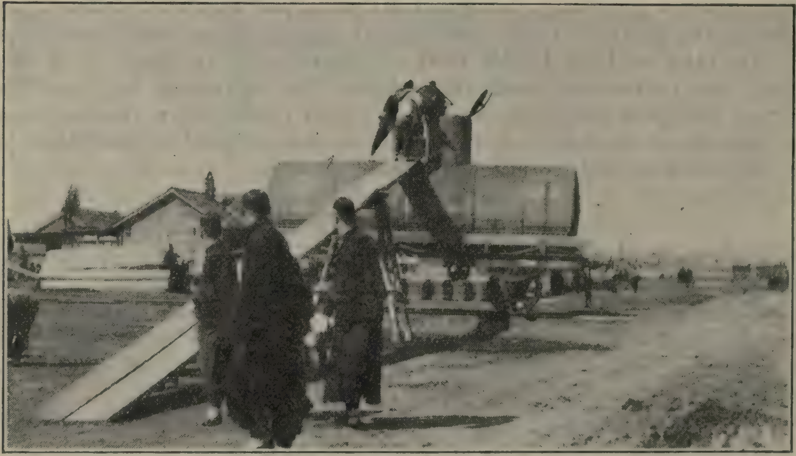

FIGURE 6.—Loading soybean oil in tanks at a soybean oil mill, Harbin, Manchuria

The utilization of the soybean and its products in industries is practically new but appears to have many possibilities. The crop is now of great value to American agriculture, especially in the Corn and Cotton Belts, not only as a cash crop for oil production but as a green-manure and pasture crop or for maintaining the fertility of the soil. The large annual importation of soybeans, soybean oil, and soybean cake into the United States, as shown in Table 2, indicates a ready market for these products.

Table 2.—*Quantity and value of soybeans, soybean cake, and soybean oil imported into the United States, 1910 to 1928, inclusive*[1]

Year	Soybeans		Soybean cake		Soybean oil	
	Quantity	Value	Quantity	Value	Quantity	Value
Fiscal year:	*Pounds*	*Dollars*	*Pounds*	*Dollars*	*Pounds*	*Dollars*
1910	----------	----------	----------	----------	Not stated.	1, 019, 842
1911	----------	----------	----------	----------	41, 105, 920	2, 555, 707
1912	----------	----------	----------	----------	28, 021, 282	1, 577, 131
1913	----------	----------	7, 004, 803	93, 002	12, 340, 185	635, 888
1914	1, 929, 435	49, 507	3, 163, 260	38, 255	16, 360, 452	830, 790
1915	3, 837, 865	87, 306	5, 975, 592	64, 307	19, 206, 521	899, 819
1916	3, 003, 065	78, 963	10, 468, 001	103, 081	98, 119, 695	5, 128, 200
1917	5, 344, 334	132, 572	11, 760, 935	136, 064	162, 690, 235	11, 410, 606
1918	31, 812, 997	692, 964	586, 820	9, 964	336, 824, 646	32, 827, 460
Calendar year:						
1918	1, 433, 349	111, 818	78, 370	1, 261	335, 984, 148	38, 454, 730
1919	4, 368, 780	201, 496	16, 988, 787	483, 221	195, 808, 421	24, 019, 226
1920	3, 136, 850	180, 759	24, 473, 132	645, 267	112, 213, 750	13, 721, 422
1921	3, 946, 173	136, 760	10, 637, 420	183, 708	17, 282, 967	700, 833
1922	3, 536, 807	145, 075	4, 282, 420	87, 683	17, 294, 094	1, 013, 172
1923	3, 648, 243	147, 559	31, 223, 638	545, 297	41, 679, 110	2, 680, 200
1924	4, 184, 120	152, 579	47, 084, 672	895, 869	9, 125, 158	623, 798
1925	3, 811, 897	150, 780	27, 801, 936	535, 800	19, 492, 900	1, 507, 219
1926	3, 727, 628	148, 099	42, 869, 187	885, 013	30, 711, 687	2, 150, 923
1927	4, 189, 168	162, 642	53, 950, 898	1, 014, 239	14, 914, 792	887, 747
1928	4, 255, 734	154, 579	96, 810, 135	1, 920, 021	13, 116, 220	823, 619

[1] Compiled from Foreign Commerce and Navigation of the U. S. Department of Commerce.

METHODS OF PROCESSING BEANS FOR OIL

The introduction of the soybean into the Western World for oil purposes has not made any marked changes in the equipment of the modern oil mills. The methods used in the extraction of oil from soybeans are similar to those used with other oil seeds, as cottonseed, linseed, and peanuts. In Manchuria the manufacture of oil and cake has not been confined to large centers, as every center of bean production has its native mill in which the method of extraction is decidedly primitive. In the last decade, however, large bean mills equipped with modern machinery have been erected at important centers of soybean production throughout Manchuria.

Different processes or methods are used in the manufacture of oil from the soybean. The oldest method of oil processing is that by expression, in which the hydraulic press or expeller is used. The hydraulic process is widely used in processing cottonseed in the South and linseed in the Northern States, but the expeller process is coming into more general use, especially where mills are being equipped solely for soybeans.

The other method of processing is by extracting the oil from the ground beans by some chemical solvent such as benzol, naphtha, or ether. The oil is then obtained by evaporating the solvent, which is distilled and used over again. The residue is well dried and is said to contain no detectable trace of the solvent. By this process nearly all of the oil is extracted, only 0.5 to 1.5 per cent of oil remaining in the meal. It is contended that more oil is obtained by this process and that the meal is well suited for flour, feed, or fertilizer, as it contains less oil. Meal or cake made by the expression methods, hydraulic and expeller, contain from 5 to 9 per cent of oil.

Extensive tests with domestic beans show that 1 ton of beans (33⅓ bushels of 60 pounds each) containing 19 per cent oil will yield by the expression method, about 250 pounds of oil and about 1,600 pounds of meal, and about 150 pounds is lost in cleaning, in milling, and in moisture.

UTILIZATION OF SOYBEAN OIL

Soybean oil belongs to the group of drying oils and stands midway in its properties between linseed oil and the semidrying cottonseed oil. Considerable variation, however, occurs in its drying qualities as well as in its color, odor, and taste, depending upon the source and variety of the bean, upon the care exercised in packing and transporting both the beans and the oil, and upon the oil-processing method. Soybean oil can be used as a substitute for either linseed or cottonseed oil, especially in soap making. In the manufacture of soft soap, soybean oil serves as an almost complete substitute for linseed oil, but unless it is hydrogenated it can but partially replace cottonseed oil in the manufacture of hard soaps.

In Europe and North America, paint manufacturers are using soybean oil as a substitute for part of the linseed oil in certain kinds of paint. Soybean oil, when properly refined, loses its characteristic "beany" flavor and can be used in the manufacture of lard substitutes, in margarine, and as a salad oil. As the process of refining is perfected there seems to be scarcely any use for which soybean oil can not be used in the manufacture of foodstuffs in which oil has a part. Other trade uses of soybean oil are in the manufacture of linoleum, rubber substitutes, core binder, lecithin, and glycerin. With the rapid growth of the soybean industry, many new trade uses for the oil have been found, and it has become an important competitor of other vegetable oils. One of the principal uses of soybean oil in Asiatic countries, chiefly China, is for food. The oil is also used in the Orient in the manufacture of foodstuffs, soap, varnish, printing ink, paints, candles, waterproof goods, and for lighting and lubricating.

SOYBEAN MEAL[1]

Soybean cake or meal remaining after processing the beans for oil is a most valuable product and has the widest usefulness. In European countries and in North America soybean meal is used almost entirely for feeding purposes. It is highly concentrated and nutritious and is relished by all kinds of livestock. In oriental countries (fig. 7) it is used very extensively for fertilizing purposes, but is also recognized as a valuable feed for work animals and for fattening stock. The use of the meal as a flour for human food is becoming increasingly important in Europe, in North America, and in the Orient.

SOYBEAN MEAL FOR HUMAN FOOD

The meal remaining after the oil is taken from yellow-seeded varieties of soybeans is bright yellow in color when fresh and has a sweet, nutty flavor. The use of this meal as flour for human food has become an important factor in several European countries during the past few years and to some extent in North America as a food of low-starch content.

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[1] By soybean meal is meant the meal or cake left after expressing or extracting the oil from the beans. Also known as soybean cake.

SOYBEAN MEAL FOR STOCK FEED

Practical experience supplemented by extensive feeding experiments in the United States and in several European countries indicates the high feeding value of soybean meal for all kinds of farm stock. Alleged injurious effects from feeding it have been reported in the United States and in Europe, but after careful investigation no proof is to be had substantiating these reports. To avoid digestive troubles that may result from the high content of protein, it should be fed with the same precautions observed with other highly concentrated feeds. The digestibility of soybean meal compares very favorably with that of other oil meals. Table 3 gives analyses of soybean meal in comparison with other similar concentrated feeds.

FIGURE 7.—Soybean cake awaiting shipment at a Manchurian port

TABLE 3.—*Analyses of soybean meal and other important oil meals*[1]

Kind of oil meal	Constituents (per cent)					
	Moisture	Protein	Fat	Nitrogen-free extract	Ash	Fiber
Soybean	7. 59	44. 65	8. 77	27. 12	5. 89	5. 96
Cottonseed	6. 62	40. 29	7. 41	28. 63	6. 21	10. 84
Linseed (old process)	8. 98	33. 23	7. 20	36. 51	5. 40	8. 68
Linseed (new process)	9. 63	37. 51	2. 49	36. 09	5. 54	8. 74
Peanut (decorticated)	10. 73	46. 84	7. 91	24. 34	4. 89	5. 29
Sunflower seed	7. 68	23. 80	7. 94	27. 49	5. 03	28. 06

[1] Average analyses as reported by the Cattle Food and Grain Investigations Laboratory, Bureau of Chemistry and Soils.

SOYBEAN MEAL FOR SWINE

At the Ohio station soybean meals, resulting from the different methods of processing soybeans for oil, showed wide variations in their value for supplementing corn for pigs. The results indicate that meals made by the expeller and hydraulic expeller processes are superior to solvent oil meals, which often have a beanlike color, odor, and taste. In stating the value of mineral supplements to corn and rape pasture, the same station found that 2 pounds each of ground limestone and bone meal saved 30.3 pounds of corn, 0.4 pound of soybeans, and 0.3 pound of salt per 100 pounds of gain. Soybean meal as a supplement to corn produced more rapid gains than tankage or ground or cooked soybeans. At the North Carolina station soybean meal was eaten readily by pigs and produced satisfactory gains when used as a supplement to corn. More profit and better gains were secured, however, when soybean meal and fish meal were mixed together in equal quantities than when the soybean meal was fed as the sole protein supplement.

SOYBEAN MEAL FOR DAIRY CATTLE

Extensive feeding experiments have been conducted in the United States and several European countries comparing soybean meal and soybean cake with cottonseed meal and linseed meal as a protein supplement in the dairy ration. Soybean meal has been found equal or superior to cottonseed meal and linseed meal for milk and butterfat production. At the Indiana station it was found that soybean meal had a feeding value for milk production equal to that of linseed meal. At the Delaware station results obtained showed that in feeding soybean meal and ground soybeans as protein supplements in the dairy ration a pound of digestible protein in ground soybeans was more efficient for milk production than a pound of digestible protein in soybean meal. Because of the high protein content of soybean meal it has a higher value per ton than ground soybeans, as much of the oil has been removed. At the same station it was found that 1 pound of digestible protein in peanut meal is 3 per cent more efficient for milk production than 1 pound of digestible protein in soybean meal, but with the higher protein content of the soybean meal the latter has a higher value per ton than peanut meal.

In feeding experiments at Copenhagen, Denmark, it was found that soybean meal, pound for pound, was just as effective for milk production as such other high-protein meals as cottonseed meal, peanut meal, and sunflower-seed meal. The Ohio station in comparing the value of soybean meal and linseed meal for milk production found the two practically equal, the difference being only 2 per cent in favor of the soybean meal. At the Mississippi station it was found that soybean meal maintained the milk flow equally as well as cottonseed meal, the amount of butterfat being slightly increased.

SOYBEAN MEAL FOR BEEF CATTLE

At the Indiana station a comparison between cottonseed meal, soybean meal, whole soybeans, and whole soybeans and mineral mixture in the rations for winter steer feeding showed that the cattle receiving a ration with soybean meal made more economical use of their feed than the cattle on the other feeds. A comparison of cottonseed meal and soybean meal as protein supplements for use in fattening beef cattle at the Illinois station showed that the steers fed the soybean meal made somewhat faster and slightly more economical gains than those receiving the cottonseed meal, but the difference between the two feeds was not large enough to be of practical significance. Both feeds proved highly satisfactory, and from the results obtained it appeared that the two have practically the same feeding value. No difficulties were met in getting the cattle to eat the soybean meal.

SOYBEAN MEAL FOR POULTRY

With the rapid expansion of the soybean industry, poultrymen have at their disposal a new poultry feed that could well be used to much greater extent than is done at present. Poultrymen in the Pacific Coast States have used soybean meal for several years and consider it a most excellent feed for flesh and egg production. A number of feeding tests at various experiment stations have shown its value as a poultry feed, although proteins from a vegetable source have been generally considered inferior to proteins from an animal source. It has been shown that the addition of a mineral mixture increases the value of the soybean meal as a protein supplement for growth and egg production.

In extensive feeding tests for egg production at the Indiana station, soybean meal, when supplemented by the proper mineral mixture, proved to be a satisfactory source of concentrated protein and gave practically the same results as animal proteins. Other feeding tests were made at the Indiana station in which meat scraps were compared with soybeans as a supplement to corn for growing chicks. The results show that when the basal ration was supplemented with varying quantities of protein from meat scraps, soybean meal, or a combination of both, the best growth resulted from the addition of 10 per cent of protein derived from soybean meal.

At the North Carolina station it was found that a mixture of equal parts of soybean meal, wheat shorts, and cracked corn moistened with sweet milk was a good ration for little chicks.

SOYBEAN MEAL AS A FERTILIZER

The use of soybean meal as a fertilizer has been confined almost entirely to Asiatic countries. For centuries soybean meal has been sent to the sugar plantations of southern China, and its use has gradually spread to the plantations in Java and other tropical islands. The high fertilizing value of soybean meal has been long recognized by the Japanese, who import large quantities annually from China for use in the rice fields and as a manure for mulberry trees. In Manchuria large quantities are used annually on poor soils for both field and garden crops. Although large quantities of soybean meal have been imported into the United States and Europe during the last few years, but little has found its way into the manufacture of commercial fertilizers.

Like cottonseed meal, soybean meal contains some phosphorus and potash, a large proportion of which is available, but its principal value in fertilizers is as a source of nitrogen. The composition of soybean meal with reference to fertilizing constituents and a comparison with cottonseed meal are shown in Table 4.

TABLE 4.—*Fertilizing constituents of soybeans, soybean meal, and cottonseed meal* [1]

Product	Constituents (per cent)			
	Nitrogen	Ammonia	Phosphoric acid	Potash
Soybean (seed)	6.51	7.90	1.36	1.82
Soybean meal	7.24	8.79	1.44	1.86
Do	7.72	9.37	1.36	1.82
Do.[2]	7.18	8.72	2.37	2.92
Cottonseed meal	6.79	8.24	2.88	1.77

[1] Analyses furnished by the Bureau of Chemistry and Soils.
[2] Solvent process meal.

MISCELLANEOUS USES OF SOYBEAN MEAL

Research chemists have been studying the value of soybean meal for industrial uses for many years, together with methods of converting it into proper form for such uses. Results indicate that the extent of possible commercial uses is limited principally by the supply of the raw product. Manufacturers of soy sauce in Japan have found from experiments that soybean meal will produce a soy sauce of better quality at a lower cost than the whole beans. Water paints, of which "solite" is a commercial product, are manufactured both in the Orient and in North America. Soybean meal has been successfully used in the manufacture of glue. Other products from soybean meal, either on a commercial basis or in the experimental stage, are size for paper, celluloid substitutes, vegetable casein, waterproofing for textiles, vegetable milk powder, and medicinal substances.

SOYBEANS FOR HAY

As indicated by the rapid increase in the soybean hay acreage during the last five years, one of the most common uses of the soybean is for hay. This hay can be fed profitably to all kinds of livestock, makes an excellent winter ration for young cattle, sheep, horses and mules, and has been used to good advantage for hogs and poultry. As a source of protein that can be produced on the farm to balance feeds for growing stock or for milk and butter production, soybean hay will reduce the quantity of high-priced concentrates that it is necessary to purchase. The feeding of soybeans alone is not to be advised as digestive troubles may result. The chief objection to the soybean for hay is that it has rather coarse, woody stems. This may be largely overcome by giving proper attention to time of harvesting, heavier rates of seeding, and by growing a good forage variety.

The principal value of soybean hay lies in its high content of digestible protein. As indicated by comparative feeding tests, it is equal to red clover or alfalfa for milk and butter production. Table 5 shows that in its content of digestible nutrients soybean hay compares favorably with the hay of other important crops.

TABLE 5.—*Analyses of soybean hay in comparison with other important hay crops* [1]

Kind of hay	Moisture	Ash	Crude protein	Carbohydrates		Fat or ether extract	Digestible protein	Digestible carbohydrate equivalent [2]
				Crude fiber	Nitrogen-free extract			
Soybean	8.4	8.9	15.8	24.3	38.8	3.8	11.2	44.0
Cowpea	9.7	12.9	17.5	20.5	36.6	2.8	11.9	37.0
Alfalfa	8.3	8.9	16.0	27.1	37.1	2.6	11.5	42.0
Red clover	12.9	6.9	13.6	24.1	39.1	3.4	8.3	43.2
Timothy	12.5	5.4	6.8	28.3	44.3	2.7	3.3	44.7

[1] Analyses compiled by the Bureau of Chemistry and Soils.

[2] The carbohydrate equivalent shown is the sum of the digestible crude fiber and nitrogen-free extract, plus 2.25 times the digestible fat.

SOYBEAN HAY FOR DAIRY CATTLE

Soybean hay has been found particularly valuable for feeding dairy cattle. In a comparison of the feeding values of soybean and alfalfa hay at the Wisconsin station the milk production on the soybean ration averaged 1.1 pounds and the butterfat 0.02 pound less per cow than on the alfalfa ration. The weights of the cows were not so well maintained on the soybean ration as on the alfalfa ration. Equal quantities of feed were given each lot, but 18 per cent of the soybean hay was refused. In further feeding tests, cows fed soybean hay produced approximately the same quantity of milk and butterfat as cows fed alfalfa, but the cows on the soybean ration wasted more of their hay and gained only about one-half as much in body weight. Practically no difference was found in the production of milk from cows fed chopped and unchopped soybean hay. There was little waste in feeding the chopped hay, and chopping in this case increased its value 23 per cent.

At the Ohio station feeding tests to compare soybean with alfalfa hay as a source of protein in the production of milk showed that a large portion of the necessary protein can be supplied as economically by soybean hay as by high-priced concentrates. Experiments at the West Virginia station indicate that good soybean hay is superior to alfalfa hay as a feed for milk and butterfat production and for maintenance of body weight for milk cows, the results in this case differing from those obtained by the Wisconsin station.

In feeding tests with dairy cows at the Mississippi station soybean hay was found slightly superior to alfalfa hay for the production of butterfat and superior to Lespedeza hay for both milk and butterfat production. Hay of the Mammoth Yellow variety of soybeans was found superior to that of the Laredo variety for milk and butterfat production. Results obtained by the Pennsylvania station in feeding trials with soybean hay for milk production showed that soybean hay of poor or medium quality is inferior in feeding value to alfalfa hay, but that soybean hay of very high quality is slightly superior to alfalfa hay. Feeding experiments at the South Dakota station indicate that soybean hay is 6 per cent more efficient for milk production and 7.8 per cent more efficient for butterfat production than good-quality alfalfa hay. Alfalfa and soybean hays were fed to dairy heifers at the Ohio station. Because the animals refused to eat the coarse stems of the soybeans, those receiving alfalfa consumed more feed than those receiving soybean hay, and the animals in the alfalfa-hay group made greater gains in all body measurements than those receiving soybean hay. The average daily gains in live weight, however, were 1.37 pounds for the cattle fed alfalfa hay and 1.43 pounds for those fed the soybean hay. The results indicate that where legume hays are available to growing heifers it is not necessary to supplement corn with concentrated proteins.

SOYBEAN HAY FOR BEEF CATTLE

At the Arkansas station soybean hay was compared with alfalfa hay for fattening steers. The steers fed alfalfa hay made an average daily gain of 2.50 pounds per head, while those fed soybean hay made an average daily gain of 2.41 pounds per head. A little less feed was required per unit of gain by the steers receiving alfalfa hay.

SOYBEAN HAY FOR HORSES AND MULES

Practical experience has shown that rations of soybean hay and corn, or soybean hay, corn, and oats. are very satisfactory for work horses. Soybean hay has also been found to be an excellent roughage for fattening mules. Horses and mules, when fed on soybean hay, finish with exceptionally smooth coats. No ill effects have been reported from the feeding of this hay, and such animals endure heat well. Results obtained at the Illinois station indicate that soybean hay when properly supplemented is a satisfactory roughage for growing draft fillies and that it is equal to alfalfa for this purpose. Soybean hay for horses and mules should be well cured and should not make up more than one-half of the total roughage.

SOYBEAN HAY FOR SHEEP

In a study of the relative values of red-clover hay and soybean hay for fattening lambs, the Iowa station found that soybean hay had a somewhat higher feeding value than red-clover hay. Considerably less shelled corn and hay were consumed by the lot receiving the whole soybean hay than by the lot receiving red clover, but when ground soybean hay was fed in comparison with red-clover hay the reverse was true. Over 20 per cent of the whole soybean hay was refused, but there was practically no waste from the red-clover hay or from the ground soybean hay. Results obtained by the Indiana station, comparing clover hay and soybean hay for fattening lambs, showed that the lambs fed soybean hay made more rapid and profitable gains than those fed clover hay. In experiments at the Illinois station shelled corn and alfalfa hay proved somewhat superior to shelled corn and soybean hay for fattening western lambs, the former ration resulting in slightly greater gains and in lower feed consumption for 100 pounds of gain. In a comparison by the Illinois station of alfalfa hay and soybean hay for feeding pregnant ewes and lambs, there was no apparent injurious effect from the soybean hay. The gains made by the lambs fed soybean hay were comparable to those made by the lot fed alfalfa, although somewhat more hay was consumed by the lambs fed soybean hay.

SOYBEAN HAY FOR SWINE

The feeding of soybean hay to hogs is practiced in some sections, the crop being cut when the beans are fairly well matured and then stacked for feeding during the winter months. At the Arkansas station soybean hay was compared with tankage for wintering brood sows. Gilts receiving soybean hay with corn farrowed especially good litters, while only one gilt in the lot receiving corn and tankage farrowed a satisfactory litter. These results indicate that soybean hay was not responsible for previous trouble with abortion which has been occurring with animals receiving this roughage.

FIGURE 8.—The soybean is an excellent crop to pasture with hogs, supplementing the corn ration

SOYBEAN HAY FOR POULTRY

Practical experience indicates that soybean hay makes an excellent winter feed for poultry, and will increase egg production. In some instances the soybeans are cut when the pods begin to form and are carefully cured to avoid loss of leaves. The practice in general, however, is to cut soybeans for hay when the seed is one-half to three-fourths grown.

SOYBEANS FOR PASTURAGE

The soybean can be utilized to advantage as pasture for all kinds of livestock. Perhaps the most profitable method is to pasture with hogs, supplementing with a corn ration. (Fig. 8.) Pasturage is especially desirable when harvesting is interfered with by weather conditions, lack of labor, or other causes, and when the crop is grown for soil improvement. Soybeans furnish a very satisfactory pasturage in late summer and early fall when perennial pasture may be short. Soybeans grow well with corn, and the two crops may be pastured down as is often done with corn alone. Soybeans may be planted in alternate rows or mixed and drilled in the same row with corn. In case it is desirable to prolong the grazing period, varieties differing in maturity may be sown, or the same variety may be sown at different dates.

SWINE ON SOYBEAN PASTURE

The soybean is an excellent crop for supplementary hog pasturage throughout the Corn Belt and most of the Cotton Belt States. It being a legume, many farmers consider the increase in fertility of the soil, where the crop is grazed, equivalent to the cost of growing it. Hogs, if turned on soybeans before they are mature, will eat the leaves and pods, and the stems to some extent. To allow the beans to ripen before grazing, however, is usually considered more profitable. Soybeans have a very marked effect on the quality of pork, and under certain conditions the feeding of them will result in the production of soft pork. Extensive tests are being carried on to determine the relation between the feeding of soybeans and the production of pork.

In a series of tests to determine the value of soybeans as a forage crop for hogs, the South Carolina station found that pigs on mature soybeans and corn made faster gains than those in dry lot on corn and tankage; soybean forage produced more economical gains than the dry-lot method of feeding hogs, and pigs on soybean forage were more thrifty than those on corn and tankage. Feeding experiments at the Kentucky station indicate that it is unprofitable to hog down soybeans alone, but that it is very profitable to hog down soybeans and corn growing in the same field or to feed corn to hogs running on soybeans. In experiments at the Iowa station less standing corn was required per 100 pounds of gain when soybean forage with corn and tankage were used than when corn alone was hogged down or the corn was supplemented with tankage alone or with soybean forage alone. The best results in the 1924 experiment in hogging down corn were obtained when soybeans were grown with corn and supplemented with self-fed tankage.

At the Missouri station experiments showed that hogs grazing corn and soybeans produced more pork per acre, made more rapid gains, and required less feed per 100 pounds gain than did hogs grazing corn alone. More pork was produced per acre, gains were more rapid, and less feed was required per 100 pounds gain with corn and tankage than with corn and soybeans. The corn-and-tankage combination produced more pork per acre and resulted in more rapid gains with a smaller feed requirement per 100 pounds increase in live weight than did the combination of corn, soybeans, and tankage, indicating that soybeans will not entirely take the place of tankage if planted in corn to be hogged off. The one year's test indicates that when a mineral mixture composed of wood ashes, superphosphate (acid phosphate), and common salt is added to corn and soybeans, the ration is superior to corn and soybeans alone, but not equal to corn and tankage or to corn, soybeans, and tankage.

The Ohio station conducted tests in which five varieties of soybeans were grown in separate plots of corn and hogged down. Although no difference was found in the chemical or physical properties of the varieties to which a difference in palatability could be attributed, the varieties ranked in the following order according to their palatability: 1, Midwest (yellow); 2, Hamilton (brown); 3, Manchu (yellow); 4, Ebony (black); and 5, Wilson (black).

SHEEP ON SOYBEAN PASTURE

Pasturing soybeans and corn with sheep is a common practice throughout the Corn Belt States. (Fig. 9.) This combination not only furnishes feed for preparing lambs for market, but also for breeding ewes. Sheep will eat the weeds, soybeans, and corn leaves before touching much of the ear corn.

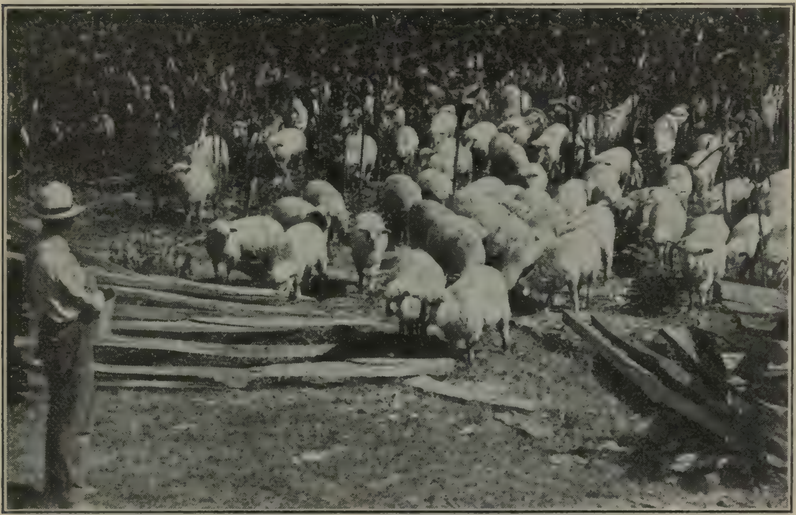

FIGURE 9.—Pasturing soybeans and corn with sheep is a common practice in the Corn Belt States

POULTRY ON SOYBEAN PASTURE

At the New Jersey station it was found that soybeans provided a continuous supply of succulent green feed during late summer and early fall, and that owing to their luxuriant growth they produced a liberal amount of shade for the growing chickens.

SOYBEANS FOR SILAGE

Although the use of soybeans alone for silage has not been recommended, more recent experiments indicate that a high-protein crop, if wilted to a proper degree of moisture content and tightly packed, may produce a satisfactory silage.

The soybean is, however, a valuable supplement to corn for silage (fig. 10), about 2 or 3 parts corn and 1 part soybeans making a well-balanced silage that keeps well, is readily eaten by stock, and produces no bad effects in the quality of milk and its products. Corn alone is an unbalanced ration and should be supplemented with feeds richer in protein. Many feeding experiments with dairy cows indicate but little difference in value between corn-soybean silage and corn silage alone. The corn-soybean silage, however, has been a very popular one, and some recent experiments have shown its superiority to corn silage. Experiments were conducted at the Arkansas station from 1917 to 1924 to determine the advantage of mixing soybeans and cowpeas with corn and cane in making silage for feeding beef and dairy cattle. From the results of all experiments it was concluded that the mixing of legumes with corn or cane produces an ensilage that keeps well and is more palatable than ensilage made from corn or cane alone. Such mixtures were also more valuable pound for pound for milk and butterfat production and for beef production than corn or cane silage alone. In feeding investigations for milk production at the Pennsylvania station, ensilage composed of one-third soybeans and two-thirds corn by green weight had a slightly higher feeding value for milk production than corn silage.

FIGURE 10.—The soybean forms a valuable supplement to corn for silage

The Maine station in an experiment with dairy cows found that the cows on corn-soybean silage with 1 pound less grain did practically as well as on corn silage. In comparing the feeding value of soybean hay and soybean ensiled with corn, at the rate of 1 part of soybeans to 2 parts of corn, at the Ohio station, an advantage of 3 per cent in feeding value was indicated for the corn-soybean silage. At the Iowa station a test of the comparative value of corn silage and corn and soybean silage showed 1.9 per cent in favor of the latter when based on the quantity of milk produced. Steer-feeding experiments at the Mississippi station showed average daily gains of 1.99 pounds for the lot on corn silage as compared with 2.15 pounds for the lot on the corn and soybean silage, but the former lot was a little better finished.

SOYBEANS FOR SOILAGE

The soybean has an important place among soiling crops (fig. 11), and having a high content of protein, may be fed to good advantage with crops that are low in protein, such as corn, Sudan grass, and millet. The range in maturity of different varieties or that which results from the planting of the same variety at different dates makes it possible to have a succession of green forage throughout the summer and fall. When the soybean has become established it grows well during periods of drought and often succeeds where other crops fail. The palatability of the soybean at all stages of development and the ease of handling the crop also make it a very valuable crop for soilage.

Table 6 shows the digestible nutrients in 100 pounds of the fresh, green roughage of the soybean compared with other crops commonly used for soilage.

TABLE 6.—*Analyses of green forage of soybeans and other crops*[1]

Crop	Moisture	Ash	Crude protein	Carbohydrates		Fat or ether extract	Digestible protein	Digestible carbohydrate equivalent[2]
				Crude fiber	Nitrogen-free extract			
Soybean	75.1	2.6	4.0	6.7	10.6	1.0	3.1	12.2
Cowpea	82.5	2.5	3.4	4.0	7.1	.5	2.6	8.8
Corn fodder (dent, mature)	73.4	1.5	2.0	6.7	15.5	.9	1.1	16.6
Alfalfa	72.9	2.6	4.7	8.0	11.0	.8	3.6	12.8
Kafir	73.0	2.0	2.3	6.9	15.1	.7	1.5	16.3
Red clover	70.8	2.1	4.4	8.1	13.5	1.1	2.9	16.4

[1] Analyses compiled by the Bureau of Chemistry and Soils.

[2] The carbohydrate equivalent shown is the sum of the digestible crude fiber and nitrogen-free extract plus 2.25 times the digestible fat.

At the Massachusetts station, in a series of soiling experiments with milk cows, favorable results both as regards yield and composition of milk were obtained from the summer feeding of crops, particularly soybeans fed with brewers' grains.

In a soiling experiment with milk cows at the Iowa station, the results in general indicate the importance of feeding plants richer in protein than corn. The butter obtained by feeding soybean forage was of superior flavor and quality.

SOYBEANS FOR SOIL IMPROVEMENT

The value of a crop of soybeans for soil improvement will depend upon the inoculation of the plants, how much of the crop is returned to the soil, and the effect of the roots upon the mechanical condition of the soil. Leguminous plants, through the aid of the root-tubercle organisms, are able to add to the available nitrogen of the soil and therefore are extensively used in restoring soils that are deficient in this element. Soybean plants with an abundance of nodules obtain from two-thirds to three-fourths of their nitrogen from the air and the remainder from the soil. If the soil is abundantly supplied with nitrates, the soybean will obtain most of its nitrogen from the soil rather than from the air. The fertilizing value of a crop of soybeans compares favorably with that of other legumes commonly grown for green manure.

According to investigations at the Ohio station, the average weight of the roots and stubble of the soybean was only about 10 per cent of the hay crop removed. The nitrogen left in the soil in the roots and stubble was about 6 pounds per acre, and that removed in the hay was about 128 pounds per acre. This indicates that little nitrogen is left in the soil through the roots and stubble, but when the soybean is harvested for seed a very large percentage of the leaves, often amounting to one-third of the total weight of the tops, is left on the ground.

FIGURE 11.—A fine growth of soybeans to be used for soiling

As a soil-improvement crop, the soybean can not be expected to be effective in adding to the fertility of the soil if the entire crop is removed and none of it returned in the form of straw, green manure, or animal manure. On certain types of soil, however, especially sandy soils, increased yields of subsequent crops have resulted even where soybeans were harvested as hay or beans. At the Virginia station, experiments showed that where soybeans were cut for hay the yield of wheat was increased 3.5 bushels per acre over that where no soybeans were grown. When the entire soybean crop was turned under for green manure the yield of wheat was 6.6 bushels per acre more than when the soybeans were cut for hay. If the soybean crop is harvested for beans and the vines left on the ground, the yield of the succeeding crop will be increased more than when the crop is cut for hay, but not so much as when the entire crop is turned under.

Table 7 shows the fertilizing constituents of the roots, stems, leaves, pods, and seed of the Midwest variety cut at different stages of maturity.

TABLE 7.—*Fertilizing constitutents of Midwest soybeans cut at different stages of growth* [1]

Portion of plant and stage of growth	Nitrogen	Potash	Phosphoric acid
	Per cent	*Per cent*	*Per cent*
Roots:			
Full bloom	1. 40	0. 60	0. 32
Seed one-half grown	1. 05	. 50	. 26
Seed full grown	. 96	. 47	. 22
Seed mature	. 64	. 22	. 11
Stems:			
Full bloom	1. 83	1. 21	. 46
Seed one-half grown	1. 80	. 91	. 41
Seed full grown	1. 08	1. 17	. 26
Seed mature	1. 01	. 58	. 22
Leaves:			
Full bloom	3. 59	1. 28	. 56
Seed one-half grown	3. 18	. 97	. 50
Seed full grown	2. 16	. 75	. 34
Pods:			
Seed one-half grown	3. 56	2. 12	. 87
Seed full grown	1. 29	1. 90	. 26
Seed mature	1. 25	1. 23	. 25
Seed:			
Seed one-half grown	5. 95	1. 80	1. 28
Seed full grown	6. 51	1. 82	1. 36
Seed mature	6. 37	1. 89	1. 38

[1] Analyses made by the Bureau of Chemistry and Soils.

The Kansas station reports an increase of 14 bushels of corn to the acre where corn followed soybeans in alternate years, as compared with corn grown continuously. At the Arkansas station, soybeans used as green manure gave nearly as good results as cowpeas, as determined by subsequent crops of wheat, oats, cotton, and corn. Soybean vines plowed under resulted in a larger yield of cotton than cowpea vines, but cowpea stubble gave a larger yield than the soybean stubble. With corn, cowpea stubble and soybean stubble gave about the same results, while the soybean vines gave better results than the cowpea vines. Experiments at the New Jersey station to determine to what extent the nitrogen supply of the soil can be maintained by growing a legume between the main crops of the rotation showed that wheat following a nonlegume yielded at the rate of 9 bushels of grain and 1,040 pounds of straw to the acre and wheat following soybeans as a green manure yielded at the rate of 17.33 bushels of grain and 2,540 pounds of straw. Rye following a nonlegume produced 15.33 bushels of grain and 1,540 pounds of straw, and, following soybeans, 21.66 bushels of grain and 2,780 pounds of straw. Following a nonlegume, the nitrogen in the dry matter of both the grain and straw amounted to 17.92 pounds per acre for wheat and 23.15 pounds for the rye, as compared with 39.13 pounds and 40.7 pounds, respectively, when grown after soybeans.

It is hardly practicable to grow soybeans for green manure alone, as they are too valuable a crop to plow under for soil improvement except under certain conditions; but in some sections they may follow wheat or oats and make sufficient growth to add considerable organic matter to the soil for winter wheat or for other fall-sown crops. For the best results as a green manure, soybeans should not be allowed to become too mature before being turned under. Immature vines decay more rapidly, and less soil moisture is consumed when the crop is turned under early than when the dry stalks are turned under. When the plant has reached the blossoming stage most of the nitrogen has been gathered and the soybean plant decays rapidly in the soil.

SOYBEAN STRAW

The straw obtained from threshing soybeans has value as roughage for all kinds of livestock. In many sections where this crop is grown extensively for the beans the straw is baled at the time of threshing and sold in the immediate locality to stock feeders.

FEEDING VALUE OF SOYBEAN STRAW

Soybean straw has been found of value as roughage for wintering dry dairy cattle and beef cattle, and it is also good for sheep. It may be fed like other straws, and supplemented by a small grain ration. Table 8 gives the digestible nutrients of soybean straw as compared with those of other roughages.

TABLE 8.—*Analyses of soybean straw in comparison with other roughages*[1]

Roughage	Moisture	Ash	Crude protein	Carbohydrates		Fat or ether extract	Digestible protein	Digestible carbohydrate equivalent [2]
				Crude fiber	Nitrogen-free extract			
Soybean straw	8.7	7.4	5.7	34.6	41.1	2.5	2.8	41.2
Wheat straw	9.6	4.2	3.4	38.1	43.4	1.3	.4	37.2
Oat straw	9.2	5.1	4.0	37.0	42.4	2.3	1.2	40.3

[1] Analyses compiled by the Bureau of Chemistry and Soils.

[2] The carbohydrate equivalent shown is the sum of the digestible crude fiber and nitrogen-free extract plus 2.25 times the digestible fat.

The results obtained in a series of experiments at the Ohio station, comparing corn stover and soybean straw for fattening lambs when fed with shelled corn and linseed meal, show that soybean straw produced 6.6 per cent greater gains on a smaller quantity of feed per 100 pounds of gain than did corn stover. The Tennessee station compared soybean straw and corn stover as roughage in the production of milk and butter and found the ration containing soybean straw to be superior to that containing corn stover. This ration produced more pounds of milk and butterfat, and produced them more cheaply, than the corn-stover ration. In every case there was less loss in milk and butterfat during the feeding of soybean straw than during the feeding of corn stover. During the last period of feeding, one lot of cows, on soybean straw, actually gained 57 pounds of milk over the preceding period on corn stover.

FERTILIZING VALUE OF SOYBEAN STRAW

Although soybean straw is more generally used for feeding, in some cases it is used for spreading on the land for its fertilizing value. The better plan would be to feed the straw if animals are available and apply the manure to the soil. When a special bean harvester is used the vines are left standing and later are turned under. Analyses of plants from which the seed had been gathered by these harvesters show 1 ton of this straw to contain 10.1 pounds of nitrogen, 2.1 pounds of phosphoric acid, and 17.6 pounds of potash. When soybeans were grown for seed production in citrus and pecan orchards, the straw left after harvesting with the bean harvesters was turned under and gave excellent results in soil improvement. Table 9 gives the fertilizing constituents of soybean straw compared with other common straws.

TABLE 9.—*Fertilizing constituents of soybean straw compared with those of wheat, oats, barley, and rye*[1]

Straw	Fertilizing constituents in 1,000 pounds		
	Nitrogen	Phosphoric acid	Potash
	Pounds	*Pounds*	*Pounds*
Soybean	9.0	1.2	8.9
Wheat	5.0	1.3	7.4
Oats	5.8	2.1	15.0
Barley	5.6	1.8	12.0
Rye	4.8	2.8	7.9

[1] HENRY, W. A., and MORRISON, F. B. FEEDS AND FEEDING. Ed. 18, 770 p. Madison, Wis., 1923.

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December 26, 1929

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FUR LAWS FOR THE SEASON 1929–30

By Frank L. Earnshaw and Frank G. Grimes, *Administrative Assistants Division of Game and Bird Conservation, Bureau of Biological Survey*

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BETTER CONSERVATION OF FUR RESOURCES NECESSARY

IF PUBLIC and private benefits from the fur resources of the Nation are to continue, appropriate conservation laws must be enacted and effectively enforced. The diminution of fur-bearing animals in recent years has served to impress all concerned with the necessity of providing them proper protection. This is the responsibility of the individual States. Some progress can be noted from year to year, though insufficient attention has been given to scientific administration of the fur resources, and in many States the open seasons permit trapping of various species at times when fur is not in prime condition.

Factors contributing to the diminution of the fur bearers include reduction of habitat, wasteful practices, and a general tendency in many sections to treat the animals as "vermin" to be killed on sight. This tendency is noted from the nature of bills introduced in some of the State legislatures this year. In a few instances protection was removed from various species for the benefit of ground-nesting game and other birds. Such action should be taken only after comprehensive scientific investigation. Assaults upon their habitats through the reduction of natural fur-producing areas, unwise drainage of swamps and marshes, and needless destruction of forests and cover also constitute serious factors tending to diminish the stocks of native fur bearers.

Wasteful practices on the part of both trappers and dealers contribute to the too-high percentage of loss in the raw-fur industry. In taking fur animals some trappers fail to confine their trapping operations to periods when the fur is prime, and in removing pelts and handling them before shipment they do not always exercise sufficient care to prevent waste. Damaged and improperly cured skins do not bring standard prices, and often are the subject of misunderstanding between shipper and purchaser. Much of the loss attributable to the encouragement of unseasonal trapping by the distribution of quotations on prime skins too early in the year has been eliminated with the discontinuance of this practice by many raw-fur receiving houses. Many reputable concerns have long realized that this encouragement of too-early trapping is unethical, and are now doing everything possible to combat the practice. Trappers allowing themselves to be encouraged in too-early trapping find that their skins are graded low, and that their financial returns are only a fraction of what they would have been had they waited for the arrival of those periods when pelts reach the highest state of perfection.

FUR FARMING AS A CONSERVATION MEASURE

The problem of conserving the remnant of the fur supply and of supplementing it from other sources must be faced by all who are interested in the future of one of the oldest industries of the country. Many fur bearers can be propagated in captivity, and with these the fur-farming industry is making substantial progress. Other species, however, can not yet be satisfactorily raised under the necessary conditions of restraint. Fur farming holds possibilities of substantial contributions to the raw-fur supply and of lucrative returns from successful ventures in its field, but the great bulk of the pelts of most species entering the fur trade must continue to be taken in the wild. Fur farming, while serving to supplement the supply of furs taken by trappers, can be deemed in no sense a substitute for the adequate and necessary conservation of the resources in wild fur-bearing animals of the individual States.

IMPROVED CONSERVATION PRACTICES

Species of fur animals that have become scarce or have diminished in numbers, or that have been adversely affected by peculiar local conditions, need more adequate protection. Protection should be extended to such species either in the form of restricted trapping seasons or by closing the season on them for a definite or an indefinite period wherever necessary to allow time for them to increase.

The practice in some States of requiring reports showing each season's catch before issuing a trapping permit for the next year should become the rule in all States and Provinces. These reports constitute the best known source of statistical data on the fur resources and afford a sound basis for accurate conclusions as to the status of the various species. Material fluctuations in the annual catch of an individual species afford a reliable index of its welfare.

Powers of game wardens and commissions are being enlarged in some States so as to permit them to provide wild-life administration programs that are sufficiently flexible to care for the fur resources under changing conditions. This practice should be extended. Inelastic laws too frequently prevent State officials from closing seasons or otherwise restricting the taking of fur animals in emergencies, or when local conditions make such action desirable. Fur animals of nearly every species should receive a full measure of protection in practically all sections of the country.

INTERSTATE SHIPMENTS OF PELTS

The United States Department of Agriculture, through the Bureau of Biological Survey, is in position to aid State authorities in apprehending and prosecuting many violators of State conservation laws through its investigations under the Federal Lacey Act governing interstate shipments of wild animals. This legislation, enacted in 1900, and amended and incorporated in the Criminal Code of the United States in 1909, prohibits the delivery of the dead bodies of wild animals or parts thereof to any common carrier for transportation from one State to another when such animals have been killed or shipped in violation of State laws. As a supplement to State legislation for the protection of wild animals, it is an important conservation measure and deserves careful study by all concerned in revising and framing State laws relating to fur animals, if the States are to avail themselves fully of its provisions. This law carries no police power, and although the Federal game protectors employed in its enforcement are not authorized to seize illegal shipments of fur or game animals, the department and the protectors under its jurisdiction maintain close cooperation with the various State organizations and officials charged with the enforcement of fur legislation. Many violators are apprehended through the activities of Federal agencies operating under this law, with resulting beneficial effect in an educational way, and the collection of thousands of dollars annually in fines imposed by State courts.

A violation of the Lacey Act is predicated upon a violation of State law, but because of the present status of fur laws in most of the States it is seldom possible to institute Federal prosecutions for illegal shipments of furs. Evidence of the actual illegal killing of fur animals is most difficult for the department to obtain as compared with the documentary evidence of shipments. For instance, frequently a State will protect beavers for a definite or an indefinite term but will fail to make provision concerning the possession, sale, or shipment from the State of the skins of such animals during the continuance of the close season or to regulate the handling of skins coming in from other States or countries.

State seizures of illegal shipments to points beyond their borders are seldom possible, but the local courts in at least one State require shippers to refund to the State the amount received in payment for illegal shipments of skins and in addition assess penalties for the violation. Such refunds are required on the theory that the shipper should not be allowed to profit by his illegal acts at the expense of the State. The widespread adoption of this method of dealing with violators would have a wholesome influence on the conservation of the fur resources of the several States.

Most reputable raw-fur houses are found to be eager to cooperate to the fullest extent in the suppression of traffic in unprime and contraband skins. The outstanding need in connection with traffic in beaver skins is a system of branding, perforating, or otherwise permanently marking those legally taken so that they may be readily identified and traced to the point of origin. With some such uniform system in the beaver-producing States reputable raw-fur dealers would be in position to refuse to handle contraband skins.

The system of tags, affidavits, and shipping permits in connection with the payment of royalties on furs in most of the Provinces of Canada appears to work to advantage in the suppression of illegal traffic in the skins of fur animals. Upon the payment of the royalty a tag is provided, half of which is surrendered for an export permit, while the stub remains attached to the skin as evidence that the royalty has been paid. The system has been further developed in British Columbia, where royalties are required to be paid on all furs intended for export and for shipment within the Province for tanning and dressing. Bales of furs for shipment are required to be inspected. Shipments must then have lead seals attached and be accompanied to destination by export permits, duplicates of which are forwarded to the game department of the Province or State to which the fur is being shipped. Other State and Provincial game departments will readily recognize the value of opportunities to check shipments of furs received from beyond their borders and the possibilities that cooperation holds for preventing illegal interstate traffic in furs.

REVIEW OF LEGISLATION OF 1929

FEDERAL LEGISLATION

The regulations under the Alaska game law affecting large brown and grizzly bears were amended to provide that residents of Kodiak and certain adjacent islands engaged in agricultural pursuits may kill these animals at any time when they are considered a menace to persons, livestock, or property. Additional protection was afforded minks in southeastern Alaska by restricting the trapping season there to the month of January. Other modifications in the regulations closed the season on minks, land otters, and weasels on the Kenai Peninsula and changed the seasons on muskrats, foxes, and lynxes in other portions of the Territory. A 22,000-acre area near Cordova, in the Eyak Lake and Power Creek region, was closed to all hunting and trapping, and thus virtually made a wild-life refuge, to meet the wishes of petitioners in that section. Hunting and trapping are also prohibited on Nunivak Island, which has been set aside by Executive order primarily as a reindeer reservation.

STATE LEGISLATION

Legislatures of all States except Alabama, Kentucky, Louisiana, Mississippi, and Virginia have been in session since the last bulletin on the fur laws was issued (Farmers' Bulletin No. 1576). The principal trends of the legislation enacted, or of regulations thereunder, are toward shorter trapping seasons, the removal of certain species from the trapping list by extending or fixing close periods for definite or indefinite terms, and increased trapping-license fees. In a few instances, however, protection has been removed, as in the case of beavers and otters in Indiana, minks in Michigan, bears in Utah and Nevada, and muskrats in Wyoming. The removal of protection from beavers, otters, and muskrats in certain instances may be attributable to oversights in general revisions of the laws. Bills introduced in various States to remove protection from foxes, minks, skunks, and other species alleged by some to be detrimental to game and other ground-nesting birds, failed of passage except in a few instances. Trapping seasons were lengthened on skunks in South Dakota from 109 to 136 days, and in West Virginia from 2 to 3 months. Georgia prohibited the use of steel traps except in salt marshes and on coastal islands.

ANIMALS ADDED TO THE PROTECTED LIST

Protection in some States for the first time was afforded certain fur animals. In Arizona a close season was provided on muskrats, raccoons, opossums, and otters, except during the period November 1 to March 1. Foxes, civet cats, and opossums were added to the protected list in Iowa; muskrats in Nevada; raccoons in New Brunswick; and lynxes in the Northwest Territories.

CHANGES IN SEASONS

Iowa provided trapping zones and reduced the season on beavers, minks, muskrats, and otters from 121 days throughout the State to 65 days in the northern zone and to 55 days in the southern; on skunks from 92 days to 65 and 55 days, respectively, in the northern and southern zones; and on raccoons from 92 to 43 days in the northern zone and to 50 days in the southern. Michigan zoned the State for trapping muskrats, and instead of the state-wide season of one month beginning on November 15, provides that these animals may now be trapped in the Upper Peninsula during the month of November, and in the southern portion of the Lower Peninsula during the month of December, the former season now applying only to the northern half of the Lower Peninsula. North Carolina provided eastern and western zones on minks, muskrats, skunks, otters, raccoons, and opossums, and shortened the season in the eastern section of the State one month except in the case of opossums, on which the season was shortened half a month.

Illinois reduced the trapping season on protected fur animals from 93 to 62 days. Maine shortened the season on foxes from 122 to 77 days, and Ohio shortened the season on foxes one month and abolished local seasons on raccoons, skunks, and opossums in nine counties, thus providing a uniform season throughout the State on these animals. Wisconsin also established uniform trapping seasons throughout the State on minks, raccoons, and otters, where local seasons and seasons in alternate years formerly prevailed. The mink, otter, fisher, marten, muskrat, and raccoon season was shortened one month in Oregon. Pennsylvania shortened the season on muskrats one month, and abolished the 1-month open season on raccoons established last year by regulation, making it two and one-half months as formerly. New Brunswick shortened the season one month on foxes.

In the Northwest Territories separate trapping seasons were prescribed north and south of the Arctic Circle; the otter season was shortened from eight and one-half months to seven and one-half months north of the circle, and to six months south, and the eight and one-half month season north of the circle on muskrats was reduced to four and one-half months, and the nine and one-half month season south to six and one-half months; the fox season south of the circle was reduced from four and one-half to three months.

Missouri and Nevada continued close seasons on beavers, and Quebec and Yukon removed them from the trapping list. In Quebec, however, Indians residing north of the Canadian National Railway may take the animals in a certain prescribed area from December 15 to March 31. Maine and Michigan prescribed special licenses for trapping beavers in areas opened by the State game officials. Michigan prescribed a limit of 15 animals to be taken under a special $10 county license. The trapping season in the Northwest Territories was shortened from eight and one-half months to five and one-half months except in the Mackenzie District, where the close season heretofore existing was continued.

The open seasons for trapping otters in Illinois and Maryland and for fishers in Minnesota were suspended for a term of years. Close seasons were continued in Michigan on otters, fishers, and martens.

BLACK BEARS

With the inclusion of a $25 bounty on bears in Maine, and the removal of protection from these animals in Nevada and Utah, this species suffered rather unusually in legislative action this year. Minnesota, however, increased protection for bears by prohibiting their hunting except in years when the deer season is open. This results in closing the season on these animals until the beginning of the fall deer season of 1930.

LICENSES AND FEES

Trapping licenses were required for the first time of nonresidents in Arizona and Oregon, and for both residents and nonresidents in Quebec. Maine and Michigan now require special beaver-trapping licenses in areas opened to trapping by the State game officials.

License fees were increased for residents in Connecticut, Nevada, and New Hampshire, and for nonresidents in Delaware, North Carolina, Nebraska, and Vermont. In Pennsylvania the fee for fur dealers' licenses was increased, and in Texas licenses are required for both dealers and buyers. In Texas also a tax is laid on skins, to be paid by the shipper, or by the trapper shipping his own catch; and tags are required to be obtained from the commission and attached to shipments before common carriers may accept them.

A new feature in license legislation was the action of Nebraska in limiting to 1,000 the number of fur-bearing animals that may be taken under the general nonresident and alien trapping license, the fee for which was increased from $25 to $100 a year, and in the proviso that an additional $5 fee must be paid for each additional 100 animals taken. A provision of similar nature in the case of fur dealers' licenses in North Carolina, where the fee was graduated according to the amount of business conducted by the dealer or operator in the State, has been abandoned this year, and definite fees established for both resident and nonresident dealers.

BOUNTIES

Bounty legislation was enacted in several States, and in one, Nevada, the former bounty authorized to be paid on lynxes was repealed. Colorado established a bounty on mountain lions; Maine on bears; South Dakota on wolves, mountain lions, foxes, lynxes, and bobcats killed between May 1 and August 31; Texas on wolves, panthers, and wildcats in certain counties; Wyoming on mountain lions, wolves, coyotes, and bobcats; and Yukon on wolves and coyotes.

SUMMARY OF LAWS

Legislation for the protection of fur animals has not progressed in some States to the stage of stringent regulation, and this condition, together with the fact that such legislation is in the formative period, makes it often exceedingly difficult to determine what restrictions apply to transporting and marketing furs. In stating the open seasons, the plan has been followed, as in the bulletin on the game laws,[1] to include *the first and last days thereof.* Statements regarding trapping on lands of another do not take into consideration the general trespass laws of the State. The bounty laws included relate for convenience to all animals and birds on which bounty is paid.

FEDERAL LAWS

Two Federal laws have a bearing on the fur industry of the United States—the Lacey Act, governing interstate commerce in wild animals, and the tariff act of September 21, 1922.

That part of the Lacey Act governing interstate commerce in wild animals (U. S. Code, title 18, sec. 392) makes it unlawful to deliver to a common carrier for transportation "from any State, Territory, or District of the United States to any other State, Territory, or District thereof" the bodies or parts of bodies of any wild animals killed or shipped in violation of the law of the State, Territory, or District in which killed or from which shipped.

The tariff act of September 21, 1922 (U. S. Code, title 19, ch. 3), places a duty of 15 per cent ad valorem on all live wild animals shipped into the United States, including silver and black foxes and rabbits. The skins of foxes, dressed or undressed, and manufactures thereof, are dutiable at 50 per cent ad valorem. Other raw furs and skins are admitted free. Furs dressed on the skin (except silver and black foxes) and not further advanced than dyeing are dutiable at 25 per cent ad valorem.

Under the tariff act, all animals imported for breeding purposes, other than silver and black foxes, are admitted free of duty when of pure breeds and registered in a book of record recognized by the Secretary of Agriculture. Since such recognition has not been given rabbits, foxes, and other fur bearers, importers of these animals do not benefit by the duty-free provision.

The regulations of the Department of Agriculture for the inspection and quarantine of foxes have been rescinded. Foxes may now be brought in at any port on presentation of importation permit and payment of the duty.

LAWS OF STATES

ALABAMA

Open seasons:[2]	*Dates inclusive*
Beaver, otter, bear, raccoon, fox, opossum, mink, muskrat (trapping)	Nov. 1–Feb. 28.

Prohibited methods: Unlawful to set traps in such manner as to endanger domestic stock.

Licenses: Fee, $15 for first trap and $2.50 for each additional trap; issued by probate judges. Landowners or landlords, and members of families may trap on own land during open season without license. Written permission required to trap on land of another.

Possession and sale: Possession of young of protected fur animals prohibited during close season. No restrictions on skins legally taken.

Shipment and export: No restrictions on skins legally taken.

Propagation: Under special permit from commissioner of game and fisheries, fur animals may be captured or possessed for propagation.

Bounties: None paid.

ALASKA[3]

Open seasons:[4]

District 1:[5]	*Dates inclusive*
Beaver, marten, sea otter	No open season.
Muskrat	Dec. 16–Apr. 30.
Land otter, mink, weasel (ermine), east of longitude 138°	Jan. 1–Jan. 31.
West of longitude 138° (see exceptions)	Dec. 16–Mar. 31.
Exceptions: On Unimak Island	No open season.
Land otter, weasel (ermine) in Kodiak-Afognak Islands group	Dec. 1–Feb. 15.[6]
Red, cross, and silver foxes, lynx	Dec. 1–Jan. 31.
Blue fox (on Aleutian Islands Reservation only)	Nov. 16–Jan. 31.

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[1] Laws relating to game animals, including deer and other big game, rabbits, and squirrels, will be found in Farmers' Bulletin No. 1616, Game Laws or the Season 1929–30.

[2] *Alabama:* Owner may protect premises in any manner at any time from depredations of fur animals. Fur animals may be hunted with dog or gun: Sept. 1–Feb. 28.

[3] *Alaska:* Regulations under Alaska game law of Jan. 13, 1925, relating to land fur animals may be obtained upon application to Secretary of Agriculture, Washington, D. C., or to Alaska Game Commission, Juneau, Alaska. For special information regarding sea otters and fur-seal fisheries and Afognak Reservation, which are subject to special legislative and administrative control, application should be made to Commissioner of Fisheries, Washington, D. C. For law and regulations governing leasing of public lands in Alaska for fur-farming purposes, application should be made to Commissioner, General Land Office, Washington, D. C.

[4] Unlawful to kill land fur animals when fur is unprime; killing of all land fur animals in Mount McKinley National Park, Katmai and Glacier Bay National Monuments, or in Eyak Lake closed area, and on Kruzof and Partofshikof Islands, and, except under permit from Secretary of Agriculture, on national bird and game refuges, or, except by occupant, on any island under lease or permit for fur-farming purposes, is prohibited.

[5] District 1 includes the Aleutian Islands, Alaska Peninsula, and neighboring islands, and southeastern Alaska, mainland and islands, from Cape Fairweather to Dixon Entrance.

[6] Kodiak-Afognak Islands Group—Dark Island on the north, Marmot Island on the east, and Tugidak and Trinity Islands on the west and south.

Open seasons—Continued.

	Dates inclusive
District 1—Continued.	
Bear, large brown and grizzly[7]	Sept. 1–June 20.
Black bear (including its brown and blue, or glacier bear, color variations)	Oct. 1–May 31.
Wolf, coyote, wolverene, marmot, ground squirrel	No close season.
District 2:[8]	
Beaver, marten, sea otter	No open season.
Muskrat, south summit of Alaska Range and Ahklun Mountains	Dec. 16–Apr. 30.
North summit of Alaska Range and Ahklun Mountains (see exception)	Mar. 16–May 31.
Exception: In Lower Kuskokwim and Yukon drainages	May 1–June 10.
Land otter, mink, weasel (ermine), south summit Alaska Range and Ahklun Mountains (see exception)	Dec. 1–Mar. 1.
Exception: On Kenai Peninsula, south of north bank of Portage Creek to its source, and easterly to head of Passage Canal	No open season.
North summit of Alaska Range and Ahklun Mountains	Nov. 16–Mar. 1.
Fox, lynx, north summit of Alaska Range and Ahklun Mountains	Nov. 16–Mar. 1.
South summit of Alaska Range and Ahklun Mountains (except blue fox, no open season)	Nov. 16–Jan. 31.
Bear, large brown and grizzly[7]	Sept. 1–June 20.
Black bear (including its brown and blue, or glacier bear, color variations) (see "Bag limits") south summit Alaska Range and Ahklun Mountains	Sept. 1–June 20.
North summit Alaska Range and Ahklun Mountains	No close season.
Polar bear, wolf, coyote, wolverene, marmot, ground squirrel	No close season.
District 3:[9]	
Beaver, marten, mink, sea otter	No open season.
Muskrat	May 1–June 10.
Land otter, weasel (ermine), fox, lynx	Dec. 1–Mar. 31.
Bear, large brown and grizzly[7]	Sept. 1–June 20.
Black bear (including its brown and blue, or glacier bear, color variations), polar bear, wolf, coyote, wolverene, marmot, ground squirrel	No close season.

Prohibited methods: Unlawful to take or kill land fur animals with poison, by use of trap or device known as the "klips," steel bear trap, or any other trap with jaws having a spread exceeding 9 inches, by aid or use of a shotgun, fire, jacklight, pit lamp, searchlight, or other artificial light, or (except polar bear) by aid of a dog. No fur animal may be taken from its home or den by digging, smoking, or use of chemicals, and no home, house, den, or runway of a beaver or muskrat may be injured or destroyed.

Bag limits: Three large brown or grizzly bears a season, except on Kenai and Alaska Peninsulas, and the Kodiak-Afognak Islands group, 2 a season. In fur district 2, south Alaska Range and Ahklun Mountains, not more than 2 black bears may be taken in September.

Licenses: Trapping: Nonresident, $50 (nonresident hunting large brown or grizzly bears must have registered guide); resident,[7] $2 (not required of native-born Indians, Eskimos, or half-breeds who have not exercised right of franchise or severed their tribal relations). Alien, $100 (special license, issued by members of commission). Fur farm, $2. *Fur dealer:* Resident, $10. Nonresident citizen, or corporation, association, or copartnership organized under laws of Territory, or a State of the United States, $250. Alien, or a corporation, association, or copartnership not organized under the laws of Territory, or a State of the United States, $500 (agents, nonresident citizen, $250; resident, $10). Licenses issued by members of commission, game wardens, and authorized agents. Licensed fur dealers must keep complete records of all fur transactions. Dealer's license not required of native-born resident Indian, Eskimo, or half-breed who has not exercised right of franchise or severed his tribal relations, or of a hunter or trapper to sell skins of fur animals he has lawfully taken, or of fur farmer to sell skins of animals raised by him, and a person not engaged or employed in the fur trade may buy furs for his own use, but not for sale.

Licensees, within 30 days after expiration of license, must report to game commission, Juneau, number and kind of fur animals taken, purchased, or otherwise procured under license. Fur dealer and fur farmer must also comply with Territorial laws and keep records.

Possession and sale: No restrictions on prime skins legally taken or on beaver or marten skins legally acquired and duly sealed by the commission on or before August 29, 1928. Fur dealers required to be licensed (see "Licenses"). Blue-fox skins must be tagged or branded before being sold.

Shipment and export: No restrictions on prime skins legally taken, but no person who is engaged in fur farming or the fur trade as a dealer or agent shall possess or transport such furs without a license. Skins of beaver and marten legally acquired and properly sealed may be possessed and transported at any time, but packages containing beaver and marten skins must be marked to show serial numbers of seals. Blue-fox skins (other than those raised on farms having a registered brand and branded with such brand) whether acquired in Territory or imported, must be tagged (fee, $1.50) by United States commissioner.

Shipment must be accompanied by statement showing number and kind of skins therein and that no unprime skin is included, such statements to be taken up and mailed to Alaska Game Commission, Juneau, by collectors of customs when by freight or express, by postmasters, when by parcel post, or direct to commission by shipper when by other means.

Nonresident citizen or alien may export 3 large brown or grizzly bears (only 2 if killed in restricted areas on Kodiak-Afognak Islands group, or Kenai and Alaska Peninsulas) under hunting license coupons and affidavit of lawful killing.

Resident may export for mounting and return within one year, 2 heads or trophies of large brown or grizzly bears legally killed, under permit, fee $1 for each trophy. Resident citizen removing from Territory may export large brown or grizzly bears legally acquired, under permit, fee $5, for each specimen. (See "Licenses.")

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[7] Large brown and grizzly bears are game animals and may be killed at any time to prevent damage to person or property. Resident license not required to take game animals. See "Bag limits" for special restrictions on large brown and grizzly bears on Kenai and Alaska Peninsulas and Kodiak-Afognak Islands group.

[8] District 2 includes mainland and islands from Cape Fairweather, Gulf of Alaska, Iliamna Lake, and Bristol Bay, northward to the headwaters of streams flowing into Arctic Ocean north of 68th parallel of north latitude.

[9] District 3 includes region drained by streams entering Arctic Ocean north of 68th parallel of north latitude and drainage of Noatak, Kobuk, Selawik, and Buckland Rivers.

Propagation: [10] License, fee $2, must be obtained from Alaska Game Commission, to conduct a fur farm or to possess fur animals for propagation. Fur animals may be taken for propagation under permit from Secretary of Agriculture and countersigned by executive officer of commission. Blue-fox farmer must register brand, fee $10.

On Aleutian Islands Reservation permits to use islands for fur farming and to trap animals for breeding purposes must be obtained from Department of Agriculture.

Public lands in Alaska for fur-farming purposes may be leased from Department of Interior under act of July 3, 1926, and regulations thereunder.

Bounties: Wolf, $15; eagle, $1; hair seal (southeastern Alaska, east 152d meridian), $2 (paid by Territory).

ARIZONA

Open seasons:	*Dates inclusive*
Beaver [11]	No open season.
Bear	Oct. 16–Nov. 15.
Muskrat, raccoon, opossum, otter	Nov. 1–Mar. 1.
Other fur and predatory animals [12]	No close season.

Bag limits: One bear a season.

Prohibited methods: Muskrat, raccoon, opossum, and otter may only be taken with guns or traps. Use of poisonous or stupefying substances prohibited.

Licenses: Hunting license required for bears (fees, nonresident, $35; resident, $2.50). Trapping licenses: Nonresident, $25; resident, $3.50. Issued by warden, designated deputies, and clerks of boards of supervisors. License not required for trapping on own land, nor of persons under 15. Traps must be inspected daily. Licensee must keep record of his catch and report to commission on or before January 10 each year. Unlawful to disturb or remove traps of licensed trappers on public domain or on lands where they have permission to trap. Traps must be tagged with metal tag showing number of owner's license. Alien prohibited from trapping.

Possession and sale: No restrictions on skins legally taken.

Shipment and export: Export of beaver skins prohibited. No other restrictions on skins legally taken, but packages must be marked with name and address of consignor and consignee and an accurate statement of contents. License coupon or shipping permit from commission must be attached to each shipment. Shipment by parcel post prohibited.

Miscellaneous: Unlawful to use fish or the flesh of any game bird or animal for trap bait.

Propagation: Under permit from State game warden, fur-bearing and predatory animals may be kept for propagation, exhibition, or sale.

Bounties: Payment of bounties is optional with county boards of supervisors.

ARKANSAS

Open seasons:	*Dates inclusive*
Bear, beaver	No open season.
Otter	Dec. 1–Jan. 31.
Fox in Arkansas, Ashely, Benton, Bradley, Clark, Clay, Cleveland, Columbia, Craighead, Crittenden, Dallas, Desha, Drew, Faulkner, Garland, Grant, Green, Hempstead, Hot Springs, Jefferson, Johnson, Lafayette, Lincoln, Logan, Miller, Mississippi, Monroe, Montgomery, Nevada, Ouachita, Perry, Phillips, Pike, Pulaski, Saline, Scott, Sebastian, Sevier, Union, Washington, White, and Yell Counties	No open season. [13] [14]
In rest of State	No close season.
Wolf, bobcat, coyote	No close season.
Other fur animals	Dec. 1–Jan. 31. [14]

Prohibited methods: No restrictions.

Licenses: Trapping license, $20 (required for use of more than 12 traps). Issued by State game and fish commission and circuit clerks. Resident using less than 12 traps or hunting fur animals off his own premises must obtain license, $1.10; not required of person under 18 trapping on own land. Nonresident must obtain hunting license to take fur animals, and, if more than 12 traps are used, also the $20 trapping license.

Possession and sale: Sale or possession of pelts taken in State prohibited, except between December 1 and February 10. Fur dealer required to file report of pelts on hand February 10 and obtain permit to possess or sell pelts during close season.

Shipment and export: No restrictions, except fur dealers must report shipments within or without State.

Propagation: State game and fish commission may issue permits to breeders of game and fur animals under such regulations as it may prescribe.

Bounties: Wolf, $15; bobcat, $5; pups and kittens, $2.50 each; paid by State game and fish commission.

CALIFORNIA

Open seasons: [15] [16]	*Dates inclusive*
Black or brown bear (see exception)	Nov. 15–Feb. 28.

Exception: In districts 1, 1½, 2, 2½, no close season until July 1, 1930.

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[10] Unlawful to feed to a fox or other fur animal held in captivity, any part of a game animal or bird other than an eagle, a raven, crow, hawk, owl, or cormorant, except waste parts such as hides, viscera, and bones.

[11] *Arizona:* Under permit of commission beaver doing damage on private property may be taken, but skins of beaver so taken must be turned over to commission for disposition.

[12] Mountain lion, wolf, fox, coyote, lynx, wildcat, skunk, or other obnoxious animals may be taken on State game preserves only under regulations of State game warden. Owner may protect his premises from depredations of predatory and fur animals, except beavers, at any time.

[13] *Arkansas:* Chasing foxes by dogs at any time permitted. Foxes so caught may be killed and pelts sold by sheriff of county for benefit of school fund of district in which taken.

[14] Fur animals found destroying crops or poultry may be killed at any time.

[15] *California:* Written permission from board of fish and game commissioners required to trap or hunt predatory animals (includes all fur animals except bears and seals) on State game refuges. Trapping licenses are not required and there are no restrictions on taking of predatory animals in districts 2, 2½, 3, 4, 4¾. License not required for bears in districts 1, 1½, 2, 2½ until after July 1, 1930.

[16] Of the 72 fish and game districts created under the act of 1917, as amended in 1929, 9 (1, 1½, 1¾, 2, 2½, 3, 4, 4½, and 4¾) are properly hunting districts; 14, 15, 23, 24, 25, and 26 are fishing districts but are open to hunting; of the other 63 districts, 37 are game refuges, 9 are special fish districts, and 17 are commercial fishing districts.

District 1 comprises the eastern half of the Sacramento and San Joaquin Valleys, including all counties not included in districts 1½, 1¾, 2, 2½, 3, 4, 4½, and 4¾.

District 1½ comprises the counties of Del Norte, that part of Siskiyou west of Southern Pacific R. R. and Klamath River, and Humboldt.

District 1¾ comprises Modoc and Lassen Counties, and Siskiyou County east of Southern Pacific R. R. and Klamath River.

District 2 comprises that part of State south of Humboldt and Tehama Counties, west of Sacramento River and north of San Francisco Bay, including counties of Glenn, Colusa, Yolo, Solano, Napa, Lake, Sonoma, and Marin, and that portion of Mendocino County not included in district 2½.

Open seasons—Continued.

	Dates inclusive
Beaver,[17] muskrat, river otter, fisher, pine marten, mink, skunk, fox, kit fox, ring-tailed cat, raccoon, wolverene (see exception)	Nov. 15–Feb. 28.
Exception: In districts 2, 2½, 3, 4, 4¾	No close season.

Prohibited methods: Unlawful to use poisons or gun larger than No. 10 gauge or trap with saw-tooth or spike jaws in taking fur animals.

Licenses:[15] Citizen, $1; alien, $2; issued by fish and game commission. License issued free to veterans of Civil War. Duplicate license issued only on affidavit of applicant that original has been lost or destroyed. License not required of persons under 18. Licensed trappers required to report catch before July 1. Licensee must exhibit license and furs to wardens or peace officers upon demand. Unlawful to disturb or remove traps of licensed trapper who is trapping on the public domain or on lands where he has permission to trap.

Possession and sale: No restrictions on skins legally taken.

Shipment and export: No restrictions.

Propagation: Fur animals may be raised in captivity under regulations of the commission.

Bounties: Mountain lion, female, $30; male, $20; paid by fish and game commission. Boards of supervisors of counties may fix the rate and pay bounty on coyote, wildcat, fox, lynx, bear, or mountain lion. Many counties now pay a bounty on some of these animals, especially on coyotes.[18]

COLORADO

Open seasons:

Beaver	No open season.[19]
All other fur animals	No close season.[20]

Prohibited methods: No restrictions.

Licenses: Hunting license required to trap: Resident: General, $5; limited, $2 (for coyote, mountain lion, wolf, bobcat, lynx); nonresident, big game, $25; small game, $5; issued by commissioner, county clerks, and other agents. Taxidermist, $5. Unnaturalized resident not permitted to hunt, capture, or kill any wild bird or animal.

Possession and sale: No restrictions.

Shipment and export: No restrictions.

Miscellaneous: Use of game or fish for trap bait prohibited.

Propagation: No restrictions, except as to beavers and game animals.

Bounties: Mountain lion, $50, from State game fund. On petition of 50 freeholders, county commissioners may levy a tax to pay bounties on coyotes, wolves, and mountain lions.

CONNECTICUT

Open seasons:[21]

	Dates inclusive
Muskrat	Nov. 1–Mar. 31.
Raccoon	Oct. 21–Dec. 31.
Fox, weasel	No close season.
Skunk, otter, mink, and other fur animals	Nov. 1–Mar. 15.

Prohibited methods: Unlawful to trap with scented baits or to take animals with a snare or similar device, to use steel traps having more than a 6-inch spread of jaws, or any steel trap having teeth. Unlawful to set steel trap except in water, in burrow of a wild animal, or on a pole at a point 8 or more feet from ground, but on own land steel traps may be set any place within 100 yards of a permanent building, or on cultivated land owned or occupied by trapper. Poisoning fur animals prohibited. Unlawful to disturb muskrat house or den or to hunt muskrats from sunset to sunrise. Unlawful to take fur animals by use of dynamite or other explosive, gas, smoke, or chemical, or by digging from burrow or den. Traps must be visited at least once in 24 hours. Owner or person using traps must have his name legibly stamped thereon.

Licenses: Hunting license required to trap: Resident, $2.25; nonresident, $10.25; issued by city, town, or borough clerk. Persons under 16 years of age are denied a hunting license, but may obtain trapping license for taking fur animals only. Licensee must wear button. License not required of residents hunting or trapping on own land during open season. Permission of owner required to trap on lands of another. *After January 1, 1930*, license fees are as follows: Resident trapping license, under 16 years of age, $2.35; over 16 years of age, $5.35. Alien may set and tend traps, during open season, on own lands used for agricultural purposes, and on which he is actually domiciled, without license. Nonresident debarred from trapping in State. Licensee required to report number of animals trapped each season. Taxidermist, $5; issued by board of fisheries and game.

Possession and sale: No restrictions on skins legally taken.

Shipment and export: No restrictions on skins legally taken.

Propagation: No restrictions on possession or sale of fur animals kept in captivity under license (fee, $2).

Bounties: Any town may pay bounty of $5 for wildcat, fox, rattlesnake, copperhead snake, and $1 for weasel, woodchuck, and wild Belgian or German hare killed within its limits.

District 2½ comprises townships in Mendocino County bordering on Pacific Ocean, except township 11 north, ranges 15 and 16 west, and townships 13, 14, 15, 16, 17, and 18 north, range 16 west.

District 3 comprises region around southern portion of San Francisco Bay and coast counties south of the Golden Gate as far as Ventura, including counties of Contra Costa, Alameda, San Mateo, Santa Clara, San Francisco, Santa Cruz, Monterey, San Luis Obispo, Santa Barbara, and Ventura; also San Benito and western half of San Joaquin, Stanislaus, Merced, Fresno, Kings, and Kern Counties.

District 4 comprises counties in southern California, namely, Los Angeles, Orange, Riverside, and San Bernardino.

District 4½ comprises counties of Mono and Inyo.

District 4¾ comprises San Diego and Imperial Counties.

Districts 23, 24, 25, and 26, all located in district No. 1, are as follows:

District 23 comprises drainage area of Lake Tahoe and Truckee River, and headwaters of American and Rubricon Rivers, in counties of Placer and Eldorado.

District 24 comprises drainage area of Silver, Twin, Blue, Meadow, and Wood Lakes in counties of Alpine and Amador.

District 25 comprises drainage area of Lake Almanor in counties of Plumas and Lassen.

District 26 comprises Sixty Lake Basin, part of Rae Lake, and to south fork of Woods Creek in Fresno County.

[15] See footnote 15 on p. 9.

[17] Beavers doing damage to levees or other protective works in reclamation, levee, or swampland districts may be taken under permit from commission, such taking to be reported within 10 days, when commission issues permit for disposition of skins.

[18] For information in regard to bounties in any county, application should be made to county clerk.

[19] *Colorado:* The owner of property being damaged by beavers may be permitted to kill them under such regulations as may be provided concerning disposition of the skins by State game and fish commissioner.

[20] A permit from State game and fish commissioner is necessary to take mountain lion, wolf, coyote, fox, lynx, wildcat, mink, marten, or wolverene on State game refuges.

[21] *Connecticut:* Fox, skunk, raccoon, wildcat mink, or weasel may be hunted or trapped on State game preserves only by superintendent of fisheries and game or persons designated by him. Fur animals may be killed at any time for protection of property.

DELAWARE

Open seasons: [22]	*Dates inclusive*
Skunk, mink, otter, muskrat	Dec. 1–Mar. 10.[23]
Fox	Oct. 1–Apr. 30.[23]
Raccoon, opossum	Oct. 15–Jan. 15.

Prohibited methods: Unlawful to use pitfall, deadfall, scaffold, cage, snare, trap, net, pen, baited hook, or baited field, or any other similar device, or any drug, poison, chemical, or explosive for taking animals protected by State laws, except muskrat, skunk, mink, and otter. Traps or other devices unlawfully set are subject to confiscation. Unlawful to destroy the nest, den, or lair of any animal protected by law. Unlawful to hunt, kill, take, or destroy any protected animal, except muskrat, skunk, mink, and otter, while the ground is covered with snow. Unlawful to shoot at or destroy any fox while it is being chased by a dog. Muskrats may not be taken during the time any flood or freshet may cause them to leave their usual places of shelter and protection, nor may they be shot at night, hunted with a dog, or taken by the method commonly known as "nailing," or by use of a "diving" or box trap.

Licenses: Hunting license required: Nonresident, $15.50; resident, $1.10 (not required in county of residence nor on own land); issued by commission. Permission of owner required to take or kill muskrats on land or marsh of another.

Possession and sale: Unlawful to sell fox or fox hide. No other restrictions.

Shipment and export: Unlawful to export fox or fox hide. No other restrictions.

Propagation: No restrictions, provided a permit is obtained from the chief game warden (fee, $1). A limited number of wild fur or game animals for propagating purposes may be taken under permit.

Bounties: Board of fish and game commissioners may pay bounties on unprotected birds.

FLORIDA

Open seasons: [24]	*Dates inclusive*
Beaver	No open season.
Muskrat, raccoon, mink, otter, civet cat (see exception)	Dec. 1–Feb. 28.
Exception: In Collier County	Nov. 20–Feb. 14.
Wildcat, weasel, skunk, panther, opossum, fox (red, gray), bear, bobcat (see exception)	No close season.
Exception: In Collier County	Nov. 20–Feb. 14.

Prohibited methods: Unlawful to use poison except within curtilage around home. Traps must be stamped with name and address of owner and visited once daily. Traps set in open must be properly safeguarded.

Licenses: Resident, $3.25 (county of residence); $10.50 (county other than county of residence); $25.50 (state-wide license). Nonresident, $25.50 (county); $100.50 (state-wide). Alien $50.50 (special, issued by commissioner). Not required of residents 65 years of age, resident Confederate veterans entitled to Florida pension, nor of children under 15. Issued by county judge. Written permission of owner required to trap on inclosed lands of another. Fur dealer: Resident, $10 (local); $100 (state-wide), and $5 for each agent or buyer employed; nonresident, $500; issued by State game commissioner. Reports required of licensed trappers and fur dealers.

Possession and sale: Skins legally taken may be possessed, bought, and sold during open season and for 30 days thereafter, except fur dealers may handle lawful skins at any time.

Shipment and export: Skins legally taken may be shipped and exported during open season and for 30 days thereafter. Fur dealers may handle lawful skins at any time.

Propagation: No legislation.

Bounties: None paid.

GEORGIA

Open seasons: [25]	*Dates inclusive*
Beaver, mink, otter, bear, muskrat, raccoon	Nov. 20–Feb. 28.
Opossum	Oct. 1–Feb. 1.
Fox (red, gray)	Sept. 1–Jan. 31.
Other fur animals	No close season.

Prohibited methods: Fox dens protected during close season. Fox, skunk, or wildcat may not be taken by trap, deadfall, or similar device. Use of steel traps prohibited except in salt marshes and islands on coast.

Licenses: Resident, $3; nonresident, $25; issued by commissioner or county warden. Permission of owner required to trap on lands of another.

Possession and sale: Prohibited during close season. Unlawful to purchase or accept furs from person who at the time is not the holder of a valid State trapping license. Dealers must make such reports as may be required by commission.

Shipment and export: Transportation company may not accept furs for shipment unless shipper exhibits his trapping license or dealer's certificate. Packages for shipment must be marked with number and kind of hides contained therein.

Propagation: Permit from commissioner required to possess fur animals for propagation.

Bounties: None paid.

HAWAII

Hawaii has no wild animals valuable for fur. There are no restrictions on the propagation of fur animals except that mongooses and rabbits may not be kept or bred. Pet rabbits may be raised if kept in confinement.

IDAHO [26]

Open seasons: [27]	*Dates inclusive*
Beaver	No open season.[28]
Marten, fisher, otter, mink, raccoon, fox, muskrat (see exceptions)	Dec. 1–Feb. 28.
Exceptions: Muskrat, in Bear Lake and Caribou Counties and Grays Lake in Bonneville County	Apr. 1–May 10.
In Jefferson County	Dec. 1–Mar. 15.
Other fur and predatory animals	No close season.[27]

Prohibited methods: Unlawful to destroy houses, dams, or other structures erected by fur animals.

Licenses: Resident, $5; nonresident, $25; alien, $50; issued by warden, deputy, or authorized agent. Licensed trapper must make verified report at end of season of number and kind of fur caught, where sold, and the price received. Unlawful to destroy, disturb, or remove traps of licensed trapper.

Possession and sale: [28] Skins of animals legally taken, within or without State, may be possessed or sold at any time. Unlawful to possess fur animals, or hides thereof, on which there is no open season in State, without permit from State game warden.

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[22] *Delaware.* Owners may kill foxes at any time when destroying their poultry, and other fur animals may be killed at any time when destroying property.

[23] In New Castle County, on embanked meadows may be taken from Dec. 1 to Mar. 20.

[24] *Florida:* Animals destructive of crops, game, fowl, or stock may be killed on own property at any time under permit from State game commissioner.

[25] *Georgia:* Fur animals destroying property may be killed at any time.

[26] *Idaho:* State fish and game warden may close season in any locality on any species of fur-bearing animal threatened with extinction. Under permit of State warden, persons may protect their own premises from depredations of fur animals, except that bears doing damage may be destroyed without a permit.

[27] All trapping is prohibited on State game preserves, except that certain predatory animals may be killed thereon by deputy game wardens and persons authorized by State game warden.

[28] State game warden may grant permits to take beavers when doing damage to irrigation canals, crops, etc., or authorize deputy warden or State trapper to take such animals. Pelts of animals taken must be turned over to warden for sale. Possession of beaver hides otherwise prohibited.

Shipment and export: No restrictions.

Miscellaneous: Unlawful to use flesh of any game animal, bird, or fish for trap bait. Unlawful to destroy houses, dams, or other structures erected by fur animals, except under permit of State warden.

Propagation: Fur-farm license, fees $10 each for mink, muskrat, marten, and skunk, and $25 for beaver, required. Renewal fees, half original charge.

Bounties: None paid.

ILLINOIS

Open seasons:[29]	*Dates inclusive*
Raccoon, skunk, opossum, fox, muskrat, mink—	
Northern zone	Nov. 1–Feb. 15.
Central zone	Nov. 15–Feb. 1.
Southern zone	Nov. 15–Jan. 15.
Otter	Nov. 15, 1933.
Other fur animals	No close season.

Prohibited methods: Houses, dens, and den trees of fur animals protected, except where they obstruct public or private ditches or watercourses. Unlawful to use spear or similar device for hunting or taking fur-bearing animals, or explosives, chemicals, or mechanical devices or smokers of any kind to drive them out of their burrows, dens, or houses, or to set trap within 10 feet of muskrat house, or use firearms in taking muskrats. Use of automobile or vehicle propelled by mechanical power, or the lights thereof, or ferret, weasel, guinea pig, or rat, in hunting or taking fur-bearing animals prohibited.

Licenses: Resident citizen, $2; nonresident citizen, $10.50; issued by county, city, or village clerk. License not required of landowners and tenants and members of families to trap during open season on the lands on which they reside. License not issued to a person under 16 without written consent of parent or guardian, nor to alien. Licensee must report monthly, not later than the 5th, all hides of fur animals taken, sold, shipped, or dealt in during period November to March, inclusive, together with names and addresses of persons to whom sold or shipped. Permission from owner, agent, or occupant required to trap on land of another.

Fur buyer, $10; wholesale fur buyer, $50. Issued by department of conservation. Buyer must keep daily register of all furs purchased. Taxidermist, $5.

Possession and sale: Possession of green hides (hides that have not been tanned) of fur animals permitted in each zone during the open season and 10 days thereafter. No other restrictions on possession and sale.

Shipment and export: No restrictions on skins legally taken and possessed.

Propagation: Permit required to conduct a fur farm on which protected animals are reared; fee $2; issued by conservation department. Permit to breed and raise ferrets, fee, $10.

Bounties: None paid by State; counties may pay bounty on groundhog and crow.

INDIANA

Open seasons:[30]	*Dates inclusive*
Raccoon, fox, opossum, skunk, mink, muskrat	Nov. 15–Jan. 15.
Other fur animals	No close season.

Prohibited methods: Traps set on land of another must be placed at least 18 inches within burrow or hollow log and must be visited at least once in each 36 hours. Muskrat houses protected except when obstructing ditches or watercourses. Unlawful to dig out fur-bearing animals or to chase them from their burrows by use of smoke, fumes, or chemicals.

Licenses: Resident, $1; nonresident, $15.50; issued by clerk circuit court and by superintendent of fisheries and game and his agents. Honorably discharged soldiers, sailors, and marines who are resident citizens of State may trap during open season without license; also resident landowners, children living with them, and tenants, may trap without license on lands occupied by them. Written consent of owner, occupant, or lessee required to trap on land of another.

Possession and sale: Possession of fur animals or green hides prohibited during close season, except that fresh skins may be disposed of during first five days of close season.

Shipment and export: No restrictions on skins legally taken and possessed.

Propagation: All animals raised in captivity are considered domestic stock, and owner may possess, sell, ship, transport, or otherwise dispose of them without regard to laws regulating killing and disposition of wild animals. Fur animals, lawfully acquired, may be possessed for breeding purposes during close season. An inspection certificate, fee $5, must be obtained from the department of conservation. Permit required to possess or harbor ferrets; fees, $10 for each single ferret, and $5 for each additional one; issued by conservation department.

Bounties: Boards of county commissioners may pay bounty on wolf, fox, groundhog, crow, owl, or hawk.

IOWA

Open seasons:[31]	*Dates inclusive*
Northern zone:[32]	
Beaver, mink, otter, muskrat, skunk, fox (red), civet	Nov. 10–Jan. 15.
Raccoon, opossum	Oct. 20–Dec. 1.
Southern zone:[32]	
Beaver, mink, otter, muskrat, skunk, fox (red), civet	Nov. 20–Jan. 15.
Raccoon, opossum	Nov. 1–Dec. 20.

Prohibited methods: Use of poison prohibited; skunk and fox dens and muskrat houses may not be injured or destroyed. Beaver, otter, mink, and muskrat shall not be taken with spear or shotgun.

Licenses: Hunting license required to trap: Resident, 10 traps or less, $1; 11 to 35 traps, $10; nonresident or resident alien, 35 traps or less, $25. Fur dealers or buyers, $25; issued by county recorder. License not issued to persons under 18 without written consent of parent or guardian. Owners of farm lands, their children, and tenants or employees, may trap on own land without license during open season. Permission of owner, occupant, or agent required to hunt or trap fur animals on cultivated or inclosed land of another. Licensee must report number of fur animals captured during open season.

Possession and sale: Skins of fur animals and parts thereof lawfully taken, within or without State, may be possessed and sold during open season and 10 days thereafter, or at any time on proof of lawful possession, or upon filing an affidavit with auditor of county in which possessed, giving an inventory of such skins and stating when taken or from whom acquired and location of premises where retained; provided that green hides in process of manufacture may be possessed at any time.

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[29] *Illinois: Northern zone* comprises Henderson, Warren, Knox, Peoria, Woodford, Livingston, and Iroquois Counties and all counties north thereof. *Southern zone* comprises Madison, Bond, Fayette, Effingham, Jasper, and Crawford Counties and all counties south thereof. *Central zone* comprises all counties not included in northern or southern zones.

[30] *Indiana:* Protected fur animals may be killed at any time on one's own premises to protect property. Destruction of such animals, however, must be reported to department of conservation within five days, and if hides are preserved, they must be sent to department or arrangements made for their disposition.

[31] *Iowa:* Fur animals may be destroyed at any time to protect public or private property.

[32] Northern zone comprises counties of Monona, Crawford, Carroll, Greene, Boone, Story, Marshall, Tama, Benton, Linn, Jones, and Jackson and counties north thereof. Southern zone comprises rest of State.

Shipment and export: Skins of protected fur animals legally taken and duly tagged (tags issued by fish and game department on request), may be exported during open season and first 10 days of close season.

Propagation: Breeder's permit, fee $2, must be obtained from State game warden to propagate protected fur animals.

Bounties: Boards of supervisors of counties may allow bounty on crow, groundhog, pocket gopher, or rattlesnake.

KANSAS

Open seasons: [33]	*Dates inclusive*
Muskrat, skunk, mink, opossum, and raccoon	Nov. 16–Jan. 31.[34]
Beaver,[35] otter	No open season.

Prohibited methods: Ferrets, poisons, or use of smoke, guns, or other devices for forcing smoke, gas, or liquids into holes, dens, or runways, prohibited. Unlawful to destroy houses, dens, or runways of fur animals. Unlawful to set or maintain more than 30 traps, which must be visited daily.[34]

Licenses: Resident, $1, issued only to holder of resident hunting license; issued by county clerk; Resident landowner and members of his family may hunt game or take fur animals on own land during open season without license, but trapping for commercial purposes must be licensed. Trapping license not issued to alien. Consent of owner or lessee required to hunt or kill wild animals on land of another. Fur dealer, resident, $10; nonresident, $25; required to keep open records and file report of each purchase of furs.

Possession and sale: No restrictions on licensees for skins legally taken. Possession permitted during open season and first 10 days of close season.

Shipment and export: No restrictions on skins legally taken. May not be shipped except during open season and 10 days thereafter, but licensed dealers may make shipments out of season under special permits.

Propagation: Quadrupeds raised in wholly inclosed preserve under license (fee, $2) may be sold at any time for breeding or stocking purposes. Shipments must be tagged to show number and kind of animals, number of breeder's license, and names and addresses of consignor and consignee, and be accompanied by permits from State warden. Licensee required to make annual report of number of animals in possession. Wild animals may be captured during open season and thereafter had in possession for breeding purposes, under rules and regulations of State warden.

Bounties: Coyote, $1; wolf, $5; crow, pocket gopher, 10 cents each; jack rabbit, 5 cents each; crow eggs, 1 cent each; paid by county.

KENTUCKY

Open seasons: [36]	*Dates inclusive*
Beaver, mink, raccoon, fox, otter, opossum, skunk	Nov. 15–Dec. 31.[37]
Other fur animals	No close season.

Prohibited methods: Traps must be set 18 inches or more within a hole, cave, or hollow log, and must be visited within each 36 hours.

Licenses: Resident, $1; nonresident or alien, $10.50. Issued by county clerk. Resident landowner, tenant, and members of family may hunt or trap on own land during open season without license. Written consent of owner or lessee required to trap on lands of another.

Possession and sale: Possession of green skins during close season prima facie evidence of unlawful taking.

Shipment and export: No restrictions on skins legally taken.

Propagation: No legislation.

Bounties: None paid.

LOUISIANA

Open seasons: [38]	*Dates inclusive*
Bear [39]	Oct. 15–Jan. 5.
Muskrat, mink, otter, raccoon, skunk, opossum, fox, weasel, alligator (except alligator in coast parishes and Orleans, St. Charles, St. John, and St. James, no close season)	Nov. 20–Feb. 5.
Beaver	No open season.
Wolf, wildcat, cougar, coyote	No close season.[40]

Prohibited methods: Unlawful to trap bear or fox at any time, or wolf, wildcat, or cougar from February 6 to November 19; use of firearms for other fur animals prohibited. Gigs, spears, pitchforks, or like devices, and explosives, chemicals, mechanical devices, or smokers to drive fur animals from dens or houses prohibited. Unlawful to destroy muskrat houses and nests, lairs, or dens of other fur animals or to set traps within 10 feet thereof.

Bag limits: One bear a day, five a season.

Licenses: [40] Resident (trapping only; authorizes not more than 250 traps in parish where holder traps), $2; issued by tax collector. Traps must be visited daily. Trapping licenses not issued to nonresidents. Resident fur buyer, $10; resident dealer, $50; nonresident buyer, $50; nonresident dealer, $250; issued by department of conservation. Hunting license required to take bear, fox, wolf, wildcat, or cougar: Nonresident, $50; resident, $1. Licensed trapper within 15 days after close of season must report to department of conservation number and kind of animals taken under license.

Possession and sale: Possession of raw or undressed furs prohibited from March 1 to November 19. Unlawful to possess raw furs without a license. Dealer must file sworn monthly statement of kind and number of pelts bought in State, and showing pelts shipped out of State.

Shipment and export: Tax, otter, 25 cents; mink, raccoon, 5 cents; alligators, 1 to 3 cents; and all other pelts, 1 cent each, must be paid on all pelts taken before being shipped out of State. All shipments must bear tags furnished by conservation department; no furs nor alligator skins may be shipped out of State except by holder of a dealer's license or by a trapper shipping his own catch; export of bear prohibited, except under written permission of commissioner. Dealer must make sworn monthly report of pelts shipped out of State.

Propagation: Fur animals raised in captivity under license (fee, $10) may be sold at any time, for stocking or breeding purposes, but may not be killed and pelted except during the open season. Fur animals for breeding purposes may not be captured except under restrictions specified in permits issued by department of conservation. Permit from department required to import wild quadrupeds into State or to export from State.

Bounties: None paid.

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[33] *Kansas:* Kansas forestry, fish, and game commission may further restrict seasons and methods of taking.

[34] Owner or legal occupant of land may destroy these animals at any time when they are destroying poultry or damaging other property.

[35] State fish and game warden may cause to be taken under his supervision as many beavers as he deems necessary for protection of property.

[36] *Kentucky:* Fur animals may be killed at any time on one's premises to protect property.

[37] Raccoon, opossum, skunk, and mink may also be taken with gun or dog from Oct. 1 to Feb. 15.

[38] *Louisiana:* Unlawful to take young of any fur animal the pelt of which has no regular market value.

[39] Bears may be killed at any time on one's own land when actually damaging property.

[40] Wolves and wildcats hunted for sport may be taken in any manner at any time and may be possessed by lawful holder of a State hunting license.

MAINE

Open seasons:[41]	*Dates inclusive*
Beaver	No open season.[42]
Bear, bobcat, Canada lynx (loup cervier), weasel, porcupine	No close season.
Other fur animals[43] (see exception)	Nov. 16–Jan. 31.[44]
Exception: Fox, in Cumberland, Knox, Lincoln, Sagadahoc, and York Counties	Dec. 1–Feb. 14.

Prohibited methods: Unlawful to use snare, swivel, pivot, or set gun, or to put out poison or stupefying substance for any animals. Traps may not be set within 25 feet of a muskrat or beaver house. Unlawful to dig out a fox den or remove foxes therefrom, except in private fox ranches; or to set traps (except "water sets") within half a mile of compact or built-up portion of a city or village outside of own land or within 1 mile of cultivated land or pasture in any organized or incorporated place without consent of owner or occupant. A bear trap must be inclosed in a "hut," or surrounded with two strands of barbed wire, 5 yards distant from trap, 4 and 5 feet, respectively, from ground. Unlawful to disturb muskrat or beaver houses.

Licenses: Trapping, $5 (in organized township); $10 (State). License does not include beaver, and is not required for bobcat or Canada lynx. Not required of minors under 18, nor of residents or members of immediate family to trap on own cultivated land (except for beaver) in organized township. Issued by commissioner. Licensee, on or before December 31 of each year, must make such report as commissioner may require. Written consent of owner or occupant must be obtained before setting traps on cultivated lands of another in an organized or incorporated place; such traps must be visited at least once in every 24 hours and any animals caught removed. Traps must be stamped or bear metal tag to show full name and address of trapper.

Beaver trapping in areas opened by commissioner permitted under $10 State license, but skins of beavers so taken must be sealed and stamped, fee $2 each.

Dealer in skins must be licensed (fee, State, $25); and must keep a record of transactions and forward same to commissioner of inland fisheries and game on or before December 31 of each year.

Possession and sale: Sale of beaver skins without seal of commissioner attached prohibited. No other restrictions on skins legally taken.

Shipment and export: Transportation of beaver skins without seal of commissioner attached prohibited. No other restrictions on skins legally taken.

Propagation: Breeder's license required to raise fur animals (fee, $10). No animals may be imported into the State for liberation without permit.

Bounties: Bobcat and Canada lynx (loup cervier), $10 each; paid by State; claim to be made within five days after killing or return from trip on which killing was done. Hedgehog, or porcupine (Maine forestry district October 15–April 1 only, paid by State), 25 cents, paid by town treasurer. Bear, $25.

MARYLAND

Open seasons:	*Dates inclusive*
Muskrat	Jan. 1–Mar. 15.
Raccoon, opossum	Nov. 2–Jan. 31.
Otter	No open season.
Other fur animals	No close season.[45]

Prohibited methods: Unlawful to take or kill muskrat in any manner, except by trapping; to dig for muskrat or in any manner molest or destroy any part of a muskrat house or den. Unlawful to hunt raccoon or opossum between sunrise and sunset, or to cut tree for catching or killing raccoon or opossum without consent of owner; use of steel traps or similar devices for catching raccoon or opossum prohibited. Possession of light for hunting muskrats at night prohibited.

Licenses: Hunting license required to trap: Resident, State, $5.25; county, $1.25; nonresident, $15.50, (fee, $5.50 for State license if applicant owns real estate in Maryland assessed at $500; $1.50 for county license in county where such real estate is located); issued by clerk of county circuit courts—in Baltimore City by clerk of court of common pleas. Licensee required to wear tag displayed on outer garment on middle of back and to carry license on person. License not issued to persons under 14 years of age without written request of parent or guardian. Owners, tenants, and their children may hunt on own land during open season without license.

Possession and sale: Possession of green hides of muskrat prohibited except from January 1 to March 25. Cured skins legally taken may be possessed at any time for business purposes.

Unlawful to buy, sell, or expose for sale, or transport from, any fox or fox hide in Baltimore, Cecil, Kent, Worcester, and Somerset Counties.

Shipment and export: No restrictions on skins legally taken and possessed.

Propagation: Game breeders' license (fee, $5) required.

Bounties: A State bounty of 50 cents each on sharp-shinned and Cooper's hawks killed in State, paid from State game-protection fund.

MASSACHUSETTS

Open seasons:	*Dates inclusive*
Mink, otter, muskrat, skunk, raccoon (see exceptions)	Nov. 1–Mar. 1.
Exceptions: In Dukes and Nantucket Counties	No close season.
Raccoon may also be hunted with dog and gun during October.	
Other fur animals	No close season.

Prohibited methods: Unlawful to open, disturb, or destroy muskrat house or to set trap within 10 feet thereof. Traps must be marked legibly with owner's name and must be removed at end of open season. Poison may not be used to kill animals, except rats, woodchucks, or other pests on one's own premises. The use of steel traps with spread of over 6 inches and "choke" traps with greater opening than 6 inches, and tooth-jaw traps, is unlawful, as is also the use of snares or, except by landowner, of scented baits. Except as otherwise stated, fur animals may only be taken by shooting or trapping, and traps may not be set in highways, cart roads, or paths.

Bag limits: Twenty-five raccoons a season.

Licenses: Nonresident citizen, $5.25. Nonresident residing in a State affording similar privileges to residents of Massachusetts, who owns real estate assessed at not less than $500, or who is a member of a hunting or fishing club or association incorporated prior to 1907, or who is a guest on written invitation of an incorporated club or association for hunting foxes, $2.25. Alien, $15.25 (applicant must have resided in State 10 days and own real estate therein to the assessed value of $500).

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[41] *Maine:* Any person may lawfully kill any wild animal, except beaver, destroying his property.

[42] Upon complaint of any water company that beavers or muskrats are polluting waters, or of any landowner that beavers are doing actual substantial damage to his property, commissioner of inland fisheries and game may declare special open season upon such waters and lands. (See "Licenses.")

[43] Special laws on fur-bearing animals in certain localities. For detailed information apply to Commissioner of Inland Fisheries and Game, Augusta.

[44] Raccoons and skunks may be hunted at night, with dog or gun Oct. 1–Dec. 15.

[45] *Maryland:* Unlawful to shoot or kill any fox in Cecil and Kent Counties while it is being pursued by dogs. Unlawful to trap foxes in Baltimore, Carroll, Calvert, Caroline, Prince Georges, St. Marys, Wicomico, and Worcester Counties, or to trap, hunt, or chase with dogs in Montgomery County, May 1–July 15.

Resident citizen, $2.25 (not issued to minors under 18; and those between ages of 12 and 18, on written application and consent of parents, or guardians, may obtain trapping license, fee, 75 cents, in discretion of issuing officer). Resident may trap during open season without license on land owned or leased on which he is actually domiciled and which is used exclusively for agricultural purposes, and not for club, shooting, or fishing purposes. Duplicate of lost or destroyed license, fee, 50 cents. Licenses issued by city and town clerks.

Licensee, during month of January, must make written report of number of fur animals trapped during preceding year.

Written consent of owner required to trap on improved or inclosed land of another. Traps must be visited at least once in 24 hours. Animals may be removed from traps on Sunday, but traps may not be set or reset on such day.

Possession and sale: No restrictions on skins legally taken during open season.

Shipment and export: No restrictions on skins legally taken during open saeson.

Miscellaneous: Introduction of fox or raccoon in Dukes County prohibited.

Propagation: May be permitted under regulations of division of fisheries and game.

Bounties: Seal, $2 (by Commonwealth); wildcat or lynx, $10; paid by town, but refunded by county.

MICHIGAN

Open seasons: [46]	*Dates inclusive*
Beaver	No open season [46]
Muskrat:	
In Upper Pensinsula	Nov. 1–Nov. 30.
In Lower Peninsula, north of township 16 north, and west of Saginaw Bay	Nov. 15–Dec. 15.
In rest of Lower Peninsula	Dec. 1–Dec. 31.
Otter, fisher, marten	Nov. 1, 1932.
Raccoon, opossum	Nov. 1–Dec. 15.
Bear	Nov. 15–Nov. 30.
Badger	Oct. 15–Feb. 1.
Mink, fox, skunk, wolf, coyote, lynx, bobcat, weasel	No close season.

Prohibited methods: Traps must have metal tag showing name and address of owner. Unlawful to trap bears or to use firearms, poisons, spears, baited hooks, explosives, chemicals, mechanical devices, or smokers to drive animals from their holes or homes; or to destroy, disturb, or molest any beaver, raccoon, or muskrat house, hole, or den. Unlawful to set trap within 6 feet of muskrat house or within 500 feet of beaver lodge or home.

Bag limits: One bear a season.

Licenses: Resident, $1.25; nonresident, $10; issued by county clerk. Special license for muskrats (issued to residents only), $1 (authorizes 20 traps; 10 cents for each additional trap, not exceeding 100); issued by director of conservation. Big-game license required to take bears: Nonresident, $50; resident, $2.50. Resident citizens and their minor children residing at home may hunt or trap without a license during open season on own inclosed lands upon which they live. License (fee, $1.25) to hunt or trap on other lands issued to minor over 12 and under 17 on application of parent or guardian, but such licensed minor while hunting or trapping must be accompanied by parent or guardian. Dealer: Resident, $10; nonresident, $50. Dealers must make monthly reports. Tanning or dressing furs, $5. Alien prohibited from hunting or taking any wild animals in State.

Special county beaver-trapping license, $10 (authorizes trapping of 15 beavers in area opened by director, but not more than 4 from any one colony); license accompanied by seals for tagging skins.

Possession and sale: Possession of carcass or skin of fur animal killed in close season prohibited. Possession of bear permitted during open season and 30 days thereafter. Skins in possession 5 days after close of open season must be reported to conservation department. Person selling skins of fur animals must report name and address of person to whom sold, and number and kind of skins sold.

Shipment and export: Export of bear prohibited, except by nonresident licensee. Skins of bears may be exported under permit. Dealers must have permit from director to export furs. Packages must be labeled with names and addresses of consignor and consignee, and contents.

Propagation: Annual license required to engage in raising fur animals; fees, $5 to $50, depending on number of animals, or acreage. Live animals and skins of animals raised in captivity must be tagged (fee, 5 cents for each tag).

Bounties: None paid.

MINNESOTA

Open seasons: [47]	*Dates inclusive*
Bear	Nov. 15, 1930.
Skunk	Oct. 20–May 1.
Raccoon	Oct. 20–Nov. 20.
Beaver, otter, fisher	No open season.
Muskrat	Mar. 1, 1930.[48]
Mink, weasel, wolf, wildcat, lynx, fox	No close season.

Prohibited methods: Use of poison prohibited, except as permitted by commissioner. Unlawful to molest or destroy muskrat or beaver house, den, dam, or abiding place; to hunt these animals with dogs; or to take muskrats in any manner except by trapping, but muskrat houses must not be destroyed in placing traps therein, and not more than 50 traps for muskrats may be operated at one time by one person. Unlawful to dig out or take red-fox cubs from dens, or to stake or set traps during close season. Traps for minks or raccoons may not be set in or under water or in a muskrat house or runway. Black bears may not be taken by use of steel traps, except under permit of commissioner.

Licenses: Trapping, issued to resident only: Fee, $1; by county auditors and authorized agents; commissioner may issue license (fee $1; bond, $500) to trap a specified number of beavers at a designated time and place (season closed in 1930); licensee must report the taking of beaver within 15 days and obtain tag from commissioner, fee, $2.50. Licensed trapper required to make report within 30 days after his license expires, showing number of each kind of fur animal taken thereunder. Owners, lessees, or members of their immediate families may trap without license during open season on own or leased land occupied by them as a permanent residence. Unlawful to enter growing grain for purposes of killing any wild animal without permission of owner. Buyer: Resident, local, $1; traveling, $10; nonresident, $25; wholesale, $1. Applicant for fur-buyer's license must furnish $1,000 bond. Buyers must make reports.

Possession and sale: Skins of beaver legally taken, when tagged (fee, $2.50), and skins of other fur animals legally taken if tagged within 5 days after close of season, may be possessed, bought, or sold at any time. Possession in close season without tags prohibited.

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[46] *Michigan:* Season on beaver closed until Jan. 1, 1930, after which open season may be prescribed by director. Under permit from conservation director fur animals, except beaver, may be destroyed on one's own premises to protect property, but hides must be disposed of as required by conservation director. Unlawful to trap on State game preserves or to trap badgers in and within 2 miles of any city public park containing more than 200 acres, of which 150 acres or more is woodland.

[47] *Minnesota:* Wild animals including beavers causing injury to property may be taken at any time under permit of commissioner, who may also issue permits to take unprotected animals on game refuges.

[48] Communicate with game and fish commissioner, St. Paul, for information as to trapping season on muskrats.

Shipment and export: Skins of beaver legally taken, when tagged (fee, $2.50) and other skins legally taken may be transported at any time. Export of red-fox cubs taken in State prohibited. Package or receptacle containing wild animals or parts thereof when transported by a common carrier must have attached a proper coupon tag bearing signature, address, and license number, of shipper, together with number and kind of animals or parts thereof contained therein, or if shipped by owner or occupant of land a signed statement that "The contents of this package were taken from animals killed on my land."

Propagation: Annual license (fee, $3 for 10 acres or less, 15 cents an acre for additional lands) from commissioner of game and fish required to operate a fur farm. Muskrat or beaver farm must be inclosed with animal-proof fence. Beavers or muskrats on area at time of inclosure must be purchased from commissioner by licensee at $10 each for beavers and 50 cents each for muskrats. Pelts of animals from fur farms must be tagged (fee, 1 cent each) before being sold or transported. Trespassing on licensed fur farm prohibited. Licensee must make annual report.

Bounties: Wolf, $15; cub wolf, $6; paid by State; county or town boards, may offer bounty on wolf, gopher, ground squirrel, groundhog, rattlesnake, crow, or blackbird.

MISSISSIPPI

Open seasons:	*Dates inclusive*
Bear	Nov. 1–Feb. 28.
Raccoon	Nov. 15-Feb. 1.
Opossum[49]	Oct. 1–Jan. 15.
Otter, mink, muskrat, skunk, weasel (trapping)	Dec. 1–Feb. 1.[49]
Beaver (Dec. 1, 1930), fox	No open season.
Wildcat	No close season.

Prohibited methods: Unlawful to trap bear, to remove a fox from the ground or a tree in any manner, or needlessly to destroy beaver houses or dams. Fur animals protected when driven from their natural habitat by high water or fire. Trapping devices must be inspected and contents removed every 36 hours.

Bag limits: One bear a season.

Licenses: Nonresident, $500 (county); resident, $10 (county); issued by sheriff. License not required to trap or hunt fur animals during open season on land owned or leased by resident. Written permission required to trap on posted land of another.

Possession and sale: No restrictions on skins legally taken during open season and first 5 days of close season.

Shipment and export: Shipment or export of green hides of fur animals prohibited except during the open season and 5 days thereafter.

Propagation: Muskrats raised on licensed preserve for commercial purposes, may be trapped thereon by proprietor December 1 to February 28. Fur animals raised on licensed preserve may be bought or sold and shipped within or out of State for propagation.

Bounties: None paid.

MISSOURI

Open seasons:	*Dates inclusive*
Beaver	No open season.
Other fur animals	Nov. 15–Jan. 15.[50]

Prohibited methods: Use of poison or smoke device in taking any protected animal prohibited. Unlawful to injure or destroy beaver dams or houses.

Licenses: Hunting license required to trap: Resident, State, $2.50; county, $1 (good in county of residence or adjoining county); issued by county clerk or license collector. Nonresident or alien, $10. Fur dealer and shipper, $5. Taxidermist, $1. Issued by commissioner. Written permission required to trap on inclosed premises of another.

Possession and sale: Possession and sale of green pelts prohibited during close season, but dry pelts may be possessed and sold during open season and until Feb. 10.

Shipment and export: Shipper must show hunting or dealer's license to transportation company or carrier. Furs taken out of season may not be possessed for any purpose. Undried or "green" pelts may be shipped only during open season, but pelts of wolves, coyotes, and wildcats may be shipped at any time and in any condition. Dried pelts may be shipped during open season and until Feb. 10. Shipments must be marked with name and address of shipper, his license number, date of shipment, and nature of contents.

Propagation: Permits to capture fur animals for propagating purposes may be obtained from State game and fish commissioner, fee, $5; breeder's permit, fee, $5.

Bounties: None paid.

MONTANA

Open seasons:[51]	*Dates inclusive*
Fisher, muskrat,[52] mink, fox	Dec. 1–Apr. 15.
Beaver,[53] marten or sable, otter, raccoon	No open season.
Other fur and predatory animals	No close season.

Prohibited methods: Unlawful to capture or kill any fur animal from an automobile or by aid or use of a set-gun, jack or other artificial light, or dog. Beaver and muskrat houses protected from injury.

Licenses: Trapping license, $10 (issued only to holder of a $2 resident general hunting license); special permit (fee, $10) required to trap beavers on own land when doing damage or to export their skins; skins of beavers so taken must be forwarded to commission for tagging (fee, 50 cents each); issued by State game warden. Fur dealer: Resident, $1; nonresident, $25; agent, $10; taxidermist, $15.

Possession and sale: Sale and shipment of beaver skins, whether taken within or coming from without State, prohibited, except that skins legally taken under permit and tagged may be shipped or sold within State or they may be exported under shipping permit from State game warden. Beaver skins coming from without State must be reported and forwarded to State warden within 3 days after arrival in State for tagging (fee, 50 cents for each tag) and then may be bought and sold, or exported under shipping permit (fee, 50 cents). No other restrictions on skins legally taken.

Shipment and export: (See "Possession and sale" and footnote 53.) No restrictions on skins legally taken, possessed, or tagged. Permit required to ship out furs; packages must be marked to show contents. Package containing beaver skins offered for transportation must be marked to show names and addresses of consignor and consignee, number of skins, and number of shipping permit.

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[49] *Mississippi:* Mink, skunk, opossum, or weasel when doing damage may be trapped at any time by owners or tenants on own holdings or by officers of the law.

[50] *Missouri:* Fur animals except beavers may be destroyed at any time and in any way by person residing on own land to protect premises from depredations, but pelts of animals so killed may be marketed in season only.

[51] *Montana:* Commission may create fur-bearing animal districts and restrict or prohibit trapping therein.

[52] Muskrats doing damage may be taken under permit of commission, except that permit is not required from June 1 to Aug. 31.

[53] Unlawful to kill beavers except when doing damage to own land, and then only under a special permit from State game warden (fee, $10), for which application must be filed between May 1 and Nov. 30. Permits expire May 1, and skins must be reported and tagged by July 1. All skins of animals so taken must be properly cured and forwarded to State game warden, Helena, to be tagged with a numbered metal tag (fee, 50 cents for each tag). Tagged skins may be sold or shipped within State, but a shipping permit (fee, 50 cents) must be attached to each shipment sent out of State.

Propagation: Fur-farm license, $5. Permit for sale of live beavers trapped in State, $3 each animal; sale restricted to holders of fur-farm licenses.

Bounties; Mountain lion, $20; adult wolf, $15, pup, $2; coyote, $2. Paid from State bounty fund on animals killed between April 1 and July 1, inclusive.

NEBRASKA

Open seasons:[54]	*Dates inclusive*
Beaver [55]	No open season.
Muskrat, east of and including Knox, Antelope, Boone, Greeley, Valley, Custer, Dawson, Gosper, and Furnas Counties	Dec. 1–Mar. 1.[54]
In rest of State	Jan. 1–Apr. 1.[54]
Raccoon, opossum, otter	Nov. 16–Feb. 15.
Fox	Nov. 1–Feb. 15.
Other fur animals	No close season.

Prohibited methods: Unlawful to use spear or like device in hunting or taking fur animals, or explosives, chemicals, mechanical devices, or smokers of any kind, or ferrets to drive fur animals from holes, dens, or houses. Unlawful to disturb or destroy den or house of fur animal except of muskrat or otter obstructing a public or private ditch or watercourse; unlawful to cut down or into any tree containing a den.

Bag limits: Three each of raccoons and opossums a day or in possession.

Licenses: Resident, $2.10; nonresident or alien, $100 (required for 1,000 or less fur animals; $5 additional for each 100 or less additional animals); buyers, $1; raw fur dealer, $10; issued by State department of agriculture and authorized vendors. Licenses not issued to persons under 16 without consent of parent or guardian.

Possession and sale: Possession of green hides prohibited, except during open season and 10 days thereafter. Permit may be procured from commission for possession for longer period. Beaver skins coming from without the State, upon being inspected and stamped by State warden, may be possessed and sold at any time. No other restrictions on skins legally taken.

Shipment and export: Green hides may be transported by express, baggage, or mail during open season and 10 days thereafter, if package is labeled (in two places) with name of consignor, number of his trapping license, and number and kind of hides. No other restrictions on skins legally taken.

Propagation: Fur animals raised in captivity under fur farmer's license (fees, $1 to $10, depending on number of animals) may be sold alive and transported for breeding purposes, and skins, when tagged and labeled with name of licensee, number of license, and kind and number of skins may be sold and transported at any time.

Bounties: Wolf, coyote, mountain lion, $2 each; wildcat, $1; ground squirrel, pocket gopher, crow, magpie, 10 cents each. Paid by county.

NEVADA

Open seasons:	*Dates inclusive*
Muskrat	Jan. 1–Feb. 28.[56]
Raccoon, marten, fisher, fox (silver and red)	Nov. 15–Mar. 15.
Bear, wildcat, bobcat, lynx, wolf, wolverene, coyote, weasel, otter, badger, mink, skunk	No close season.
Beaver [57]	Jan. 1, 1934.

Prohibited methods: Unlawful to take fur animals in any manner except by trap or gun, or to molest or destroy any muskrat nest.

Licenses: Hunting license required: Resident citizen, $2.50; nonresident citizen, $10. Issued by county clerk, State fish and game warden, or his deputies. License not required of minors under 14, nor of persons trapping on own land. Special county license for muskrat: Resident of State, $2.50; nonresident of State, $10. Good only in county of issue.

Possession and sale: Unlawful to possess beaver or other skins unless it can be shown that they were legally taken. No other restrictions.

Shipment and export: No restrictions on skins legally taken.

Propagation: Game or fur animals (except beaver and otter) raised in a licensed preserve (fee, $25) may be sold or shipped at any time under invoice.

Bounties: Mountain lion, $5; paid by county. Counties pay bounty of 1½ cents each for pocket gophers when at least 100 heads are presented at one time.

State board of livestock commissioners is authorized to pay bounty from funds derived from tax on horses, cattle, and hogs. The reward for coyote, coyote pup, wildcat, or lynx is 75 cents each; for mountain lion, $5.

State board of sheep commissioners is authorized to pay bounty from funds derived from tax on sheep, payments being same as those made by board of livestock commissioners.

NEW HAMPSHIRE

Open seasons:[58]	*Dates inclusive*
Marten or sable, otter, fisher, mink, muskrat, skunk, fox[59] (see exception)	Nov. 1–Feb. 28.
Exception: In Carroll, Coos, and Grafton Counties	Oct. 20–Feb. 28.
Raccoon (see exception)	Nov. 1–Dec. 31.[59]
Exception: In Carroll, Coos, and Grafton Counties	Oct. 20–Dec. 31.
Beaver	No open season.
Other fur animals	No close season.

Prohibited methods: Bear traps must be safeguarded in a substantial manner. Use of poison or set guns or snares is prohibited. Unlawful to destroy house, den, or burrow of any fur animal or to set a trap in or at entrance of a muskrat house.

Licenses: Resident, $2.15 ($5.15 effective January 1, 1930); nonresident, $25.15; issued by commissioner or agents. Resident fur dealer: $25 (State); one or more counties, each county, $3; issued by fish and game commissioner. Fur dealers must keep records and furnish copy to commissioner during January of each year. Persons selling or shipping furs outside State other than through resident buyer must keep same records and make same reports as fur dealers. License not required of resident landowners and their minor children to trap on own farmlands during open season. No person may trap on lands of which he is not owner or lessee without written permission of owner. All metal traps must be legibly marked or stamped with trapper's name, and must be visited at least once every 24 hours. Unlawful to take traps of another or to remove fur animals from them. Trappers are liable for any damage to domestic animals by traps.

Possession and sale: Possession of fur animals permitted only during open season, but skins legally taken may be bought or sold at any time. Nonresident dealers may purchase furs from licensed resident dealers.

Shipment and export: No restrictions on skins legally taken and possessed.

Miscellaneous: Unlawful to tear down or destroy any fence or wall, leave open any gate or bar, or trample or destroy any crop on land of another while trapping or pursuing wild animals.

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[54] *Nebraska:* Fur animals, except beavers, may be taken at any time for the protection of property, but permit must be obtained to destroy muskrats.

[55] Beavers damaging or destroying property may be trapped or otherwise removed by commission, or owner may do so under permit. Pelts of beavers so killed shall be sold and proceeds paid to State game fund.

[56] *Nevada:* Boards of county commissioners may change season on muskrats.

[57] Beavers doing damage to property may be trapped under authorization from board of fish and game commissioners. Furs of animals so taken must be preserved and turned over to board for sale, half of proceeds to be returned to trapper. Other fur animals injuring property may be killed in any manner at any time.

[58] *New Hampshire:* Fur or predatory animals may be killed at any time when destroying domestic animals or fowls.

[59] Raccoons and foxes may also be taken by use of dog and gun during October.

Propagation: Permit (fee, $2) required to propagate fur animals, game, or fish.

Bounties: Bear, $5; hedgehog, 20 cents; bobcat or lynx, $20; paid by fish and game department.

NEW JERSEY

Open seasons:	*Dates inclusive*
Skunk, mink, muskrat,[60] otter	Nov. 15–Mar. 15.
Raccoon	Oct. 1–Dec. 15.
Beaver	No open season.
Other fur animals	No close season.[61]

Prohibited methods: Muskrat, skunk, mink, and otter may be taken by trap only. Unlawful at any time to disturb the lodge or nesting chamber of a muskrat. Raccoons may not be trapped, but may be hunted with dogs and firearms, without permit, from sunset to sunrise in season.

Licenses: Hunting and fishing license required to trap: Nonresident and alien, $10.50; resident, $1.65. Issued by county, city, or town clerk, salaried wardens, or registrars of licenses. Alien required to own real estate to value of $2,000 above encumbrance to obtain license. Licensee must wear license button. Resident minors under 14 may trap without license. Occupant and immediate members of his family residing on farm may trap thereon without license during open season.

Possession and sale: Possession of raccoon permitted during open season and 10 days thereafter, except they may be possessed at any time under a breeder's license, but skins legally taken may be possessed and sold at any time. Possession of live fox prohibited except by permission of board of fish and game commissioners.

Shipment and export: Export of raccoon prohibited, except by nonresident licensee, or holder of breeder's license, but pelts of raccoons legally taken may be exported at any time. No other restrictions on skins legally taken or possessed.

Miscellaneous: Unlawful to molest trap set by another or to take animal caught in such trap. Unlawful to liberate fox in State.

Propagation: Raccoons may be raised or kept in captivity under breeder's license; no other restrictions except those imposed by close seasons, during which fur animals may not be taken for breeding purposes.

Bounties: Fox, $3; woodchuck, amount, not exceeding 50 cents, fixed by boards of chosen freeholders; paid by counties.

NEW MEXICO

Open seasons:	*Dates inclusive*
Beaver	No open season.[62]
Bear	Oct. 10–Oct. 31.[62]
All other fur animals	No close season.

Prohibited methods: No restrictions.

Bag limits: One bear a season.

Licenses: Big-game license required to take bears. Nonresident: General, $35.25; game, $30.25; big game, $25.25. Resident: General, $5; game, $4.50; big game, $3. Issued by county clerks and deputy wardens. Alien resident of State or an adjoining State not permitted to hunt or to own or possess shotgun or rifle in State.

Possession and sale: No restrictions on skins legally taken.

Shipment and export: Export permit for bear required (fee, $1.25). No restrictions on skins legally taken.

Propagation: Permit from State game warden required.

Bounties: None paid by State.

NEW YORK

Open seasons:	*Dates inclusive*
Bear	Oct. 15–Nov. 15.
Mink, sable	Nov. 10–Mar. 15.
Skunk	Nov. 10–Feb. 10.[63]
Muskrat (see exception)	Dec. 1–Mar. 31.
Exception: In Clinton, Essex, Franklin, Hamilton, Jefferson, Lewis, St. Lawrence, Warren, Washington, and that portion of Herkimer County north of the towns of Ohio and Russia	Dec. 1–Apr. 20.
Raccoon	Nov. 10–Feb. 10.
Beaver	No open season.[64]
Otter, fisher, fox	No close season.

Prohibited methods: Use of chemicals, gas, or other poisonous substances prohibited. Skunks may not be taken by the aid of dogs or by digging out or driving them from dens or holes by smoking. Unlawful to kill muskrats by shooting, except they may be taken with a 22-caliber rifle in the counties bordering upon Lake Champlain; to take them in box, wire, or cage traps; or to molest, injure, or disturb muskrat houses or dens. Raccoons may not be taken from dens or houses, or by cutting den trees. All traps must be stamped legibly with owner's name, and, except in the Adirondack and Catskill parks, must be inspected at least once in each 24 hours. Traps used for taking fur animals protected by law may not be staked or set during close season.

Bag limits: One bear a season.

Licenses: Resident, $1.25; nonresident, $10.50; issued by county, city, town, or certain village clerks, inspectors, game protectors. Owners or lessees and members of immediate families actually occupying cultivated farm lands may trap fur animals thereon without license during open season. Minors under 16 may trap fur animals without a license. Indian resident or member of Six Nations residing on reservation wholly or partly within State, fee, $1.25. Only licensed Indians residing on a reservation may take fur animals thereon. Alien not permitted to hunt or kill wild animals except under special license from the conservation department, or to own or possess shotgun or rifle.

Possession and sale: Fur animals may be possessed during open season only, but hides of fur animals legally taken and possessed may be bought or sold at any time.

Shipment and export: Shipment and export prohibited, except hides of fur animals legally taken and possessed may be transported at any time.

Propagation: Protected fur animals may be kept alive in captivity for propagation and sale, under license from the conservation department (fee, $5). No fur-bearing animals may be kept, which are taken wild during close season for such animals (unless taken under license); nor may they be disposed of during close season except for propagation. The conservation department is authorized to issue license to capture animals for propagation: Fee for permit, $1. License to breed, sell, or possess ferrets, fee, $10.

Bounties: None paid.

NORTH CAROLINA

Open seasons:[65]	*Dates inclusive*
Bear	Oct. 1–Jan. 15.
Beaver	No open season.

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[60] *New Jersey:* Muskrats may be killed at any time by owner of canal or dam which they are destroying.

[61] Foxes may be hunted with hounds and firearms in daylight from Nov. 10 to Apr. 30, except during open season for deer (Dec. 17 to 21). Killing of fox must be reported to commission or county warden within 48 hours.

[62] *New Mexico:* When destroying property beavers and bears may be killed under permit from State game and fish warden. Skins of beavers so taken must be turned over to State warden for disposition, half of proceeds going to permittee.

[63] *New York:* If injuring property, skunks may be taken at any time and in any manner, but the skins of animals so taken shall not be possessed, sold, bought, or trafficked in.

[64] In sections of State designated by conservation department beavers may be trapped from Mar. 1 to Mar. 31.

[65] *North Carolina:* Board of conservation and development may make regulations governing use of steel traps in taking fur animals, and may prohibit their use in any county or district upon petition and hearing. Animals committing depredations may be taken at any time.

Open seasons—Continued.	*Dates inclusive*
Mink, muskrat, skunk, otter, raccoon, east of and including Person, Orange, Chatham, Moore, Richmond, and Scotland Counties	Nov. 15–Feb. 15.
In rest of State	Nov. 1–Feb. 15.
Opossum, east of and including Person, Orange, Chatham, Moore, Hoke, and Scotland Counties (except in Lee County, Oct. 15–Feb. 15)	Nov. 15–Feb. 15.
In rest of State (except in Haywood, Jackson, and Macon Counties, Nov. 1–Feb. 15)	Oct. 15–Feb. 15.
Fox, wildcat	No close season.

Prohibited methods: Unlawful to set steel trap for bear. Use of poison or artificial light prohibited. Unlawful to cut down den trees of fur animals.

Licenses: Resident: Hunting and trapping, $5.25 (State); $3 (county); trapping, $3.25 (State); $2.25 (county). Nonresident: Hunting and trapping, $35.25; trapping, $25.25. Nonresident owning land in State may obtain license to trap thereon (fee, $5.25). Issued by clerks of superior courts, wardens, and deputies. Resident landowner and dependents under 21, and lessees, may trap on own or leased lands without license. Minor under 16 resident of State may trap under license of parent or guardian, and nonresident minor child of resident may obtain resident license when visiting parent. Raw-fur buyers or dealers: Resident, state-wide license, $100; county, $10, and $10 for each additional county. Nonresident, state-wide, $400, and $50 in addition to be collected by each county in which he conducts business. Dealers and buyers must make annual reports.

Possession and sale: Skins of fur animals lawfully taken may be bought, sold, and possessed at any time.

Shipment and export: No restrictions on skins lawfully taken.

Propagation: Fur animals may be taken for propagation under permit (fee, $1) of director, department of conservation and development.

Bounties: Wildcat, $2; hawk or crow, 25 cents each. Paid by department of conservation and development through county game wardens.

NORTH DAKOTA

Open seasons:[66]	*Dates inclusive*
Mink, weasel, raccoon, fox	Nov. 1–Mar. 31.
Muskrat	Dec. 15–Feb. 15.
Skunk, badger	Oct. 1–Feb. 28.
Beaver, otter	No open season.[67]
Other fur animals	No close season.

Prohibited methods: Unlawful to cut into, molest, destroy, or dynamite any beaver dam or beaver or muskrat house or mound, or to shoot or spear muskrats.

Licenses: Resident, $2; nonresident, $25; issued by commissioners, deputies, and county auditors. License not required of person under 16 or of resident or members of family residing permanently with him to trap on own cultivated land, during open season. Fur dealers: Nonresident buyer or shipper or agent, $50; resident shipper or buyer, $5 for each place of business in State; resident traveling agent, buyer, or shipper, $15; issued by game and fish commission. Unlawful to trap muskrats on posted lands of another. Aliens prohibited from hunting, taking, or killing any wild animal, except in defense of person or property.

Possession and sale: Skins of fur animals legally killed may be possessed or sold during open season and first 10 days of close season. Possession and sale during close season allowed under permit.

Shipment and export: Shipment and export prohibited except under permit and tag. Owners, tenants, and minors under 16 shipping furs trapped on own premises without license must mark package with name and address and number and kind of furs shipped. Report required annually of dealers of furs bought, sold, or shipped.

Propagation: State game and fish board issues permits (fee, $5) to breed and domesticate fox, mink, muskrat, skunk, and raccoon, and also permits to sell or ship them when raised in captivity. Under permit from board and $500 bond, such fur animals may be taken at any time for breeding purposes. Annual reports are required of licensed breeders.

Bounties: Adult wolf or coyote, $3; pups, $1.50 each.

OHIO

Open seasons:[68]	*Dates inclusive*
Raccoon,[69] skunk, opossum	Nov. 15–Feb. 1.
Fox	Nov. 15–Jan. 1.
Mink	Nov. 15–Mar. 1.
Muskrat, in Lake Erie trapping district	Dec. 1–Mar. 15.[70]
In inland trapping district	Nov. 15–Mar. 1.[70]
Other fur animals	No close season.

Prohibited methods: Unlawful to dig out or destroy the house, den, or burrow of fur animals or to smoke or drown the animals therefrom. Unlawful to spear muskrats, or to take raccoons from dens.

Licenses: Resident citizen, $1.25; nonresident citizen, $15.25; issued by county and township clerks and clerks of common pleas courts. License not required of owners, managers, tenants, or their children to trap during open season on own land. Written permission from owners or authorized agents required to trap on lands of another.

Possession and sale: Possession of fur animals during close season prohibited, but skins legally taken may be possessed or sold at any time. Raccoons legally taken may be possessed alive in inclosures as pets.

Shipment and export: Shipment and export prohibited, except that skins legally taken may be transported at any time. Packages containing fur animals or parts thereof when transported by common carrier must be marked to show contents, initial point of billing, and names and addresses of consignor and consignee.

Propagation: No restrictions, except those that prevent capture of wild stock in close season.

Bounties: Townships pay a bounty of $1 each on certain hawks and the great horned owl, and 25 cents on crows.

OKLAHOMA

Open seasons:[71]	*Dates inclusive*
Beaver, otter, mink, marten, or sable	No open season.
Bear (see exception)	No close season.
Exception: In Blaine, Caddo, Comanche, Kiowa, and Major Counties	No open season.
Raccoon, fox, opossum, skunk, muskrat, civet cat, badger	Dec. 1–Jan. 31.[72]

Prohibited methods: Use of traps (other than smooth-jawed single-spring steel trap having spread of not more than 4 inches), snare, deadfall, or other device, prohibited. Traps must be visited once in 24 hours. Unlawful to set trap in the open, or in path, road, or runway of domestic animals or dogs.

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[66] *North Dakota:* Fur animals (except beavers) may be killed at any time to protect one's own property.

[67] Beavers doing damage may be taken by bonded deputies or agents of commission, but skins or live animals so taken are property of commission.

[68] *Ohio:* Protected fur animals, when damaging property, may be destroyed by owners or tenants of land (except on Sunday). Skins may not be removed from animals so killed.

[69] Raccoons may not be taken except from 6 p. m. to 6 a. m. and at field trials.

[70] "Lake Erie trapping district" includes Lake Erie and waters, lands, and marshes adjacent to or within 10 miles thereof; "inland" district includes rest of State.

[71] *Oklahoma:* Fur-bearing animals may be killed at any time when found actually destroying livestock or poultry.

[72] Raccoons and foxes may be chased with dogs for sport July 1–Feb. 28.

Licenses: Trapping license issued only to holder of hunting license. Resident citizen, $1.25 (not to exceed 10 traps); professional trapper, $50 (required of resident citizen using more than 10 traps); nonresident, $250. Issued by warden, deputy, or county clerk. Licensed trappers required to report within 30 days after expiration of license all pelts taken, sold, or shipped, with names and addresses of persons to whom disposed of. Trapping license not issued to person under 14, nor to person under 16 without consent of parent or guardian. License not required of resident landowners, tenants, or their children to trap on land owned or occupied by them. Written consent of owner required to trap on occupied lands of another. Fur buyer, $3; wholesale fur buyer, $25; issued by State game warden. All licensed fur buyers required to keep daily records and render monthly reports.

Possession and sale: Unlawful to sell or possess pelts of fur animals except during open season and first 10 days of close season.

Shipment and export: No restriction during open season and first 10 days of close season on skins lawfully taken or acquired.

Propagation: State game warden issues permits to propagate fur-bearing animals (fee, $2, together with fees for tagging). Licensed breeders may sell and transport animals raised in preserves under rules prescribed by warden.

Bounties: County commissioners are authorized to offer bounty on gray wolves or coyotes ($5), and may also pay bounty of not exceeding 5 cents each on crows, English sparrows, hawks, rabbits, prairie dogs, pocket gophers, and ground squirrels. Chaparral bird (road-runner), 25 cents, paid by State.

OREGON

Open seasons:[73]	*Dates inclusive*
Beaver, west of Cascades (except in Coos, Curry, Jackson, and Josephine Counties, and east of a line through town of Scottsburg in Douglas County, and south of Portland-Astoria highway in Clatsop and Columbia Counties, no open season); east of Cascades in Crook, Deschutes, Jefferson, Klamath, and Lake Counties only	Dec. 1–Feb. 28.[74]
Mink, otter, fisher, marten, muskrat, raccoon	Dec. 1–Feb. 28.[74]
Bear in Jackson, Josephine, and Klamath Counties—no close season elsewhere	Nov. 1–Nov. 30.
Other fur animals	No close season.

Prohibited methods: Unlawful to destroy muskrat house, except where it obstructs ditch or watercourse.

Licenses: Resident trapping, $2; not required for trapping on own premises; issued by State game commission. Nonresident must obtain hunting license (fee, $15). Special beaver trapping license, fee, $2. Taxidermist, $5. Fur dealer, $3. Licensee must keep chronological record showing number and kind of furs purchased, and names and addresses of persons from whom obtained, and make verified annual report to commission. Unlawful for unnaturalized persons to hunt or trap without gun license ($25) and hunting license. Unlawful to remove or disturb traps of a licensed trapper on public domain or on land where he has permission to trap. Licensed trappers are required to make verified annual reports of number of animals caught, receipts for fur, and where sold.

Possession and sale: Possession and sale prohibited, except that animals or hides legally taken within or without State may be possessed or sold at any time.

Shipment and export: Shipment and export prohibited, except that skins of animals legally taken may be shipped at any time.

Miscellaneous: Unlawful to use flesh of game bird or animal for trap bait.

Propagation: Permit (fee, $2) to keep fur-bearing animals may be obtained from State game commission. No wild fur animals may be taken for propagating purposes in close season nor may those held in captivity under permit be sold in that season. Yearly reports to commission required.

Bounties: State game commission is empowered to pay bounties on any predatory animal in order to protect game; under this act it now pays $25 each for wolf and cougar.

PENNSYLVANIA

Open seasons:[75]	*Dates inclusive*
Bear (over 1 year old)	Nov. 10–Dec. 15.[76]
Muskrat	Dec. 1–Feb. 28.
Raccoon	Nov. 1–Jan. 15.
Skunk, mink, otter, opossum	Nov. 1–Feb. 28.
Fox, wildcat, weasel	No close season.[77]
Beaver	No open season.

Prohibited methods: Unlawful to take bears with steel trap, deadfall, or pen, or to shoot them except with a single bullet, but the use of steel-jacketed bullets is prohibited. Use of automatic firearms prohibited. Steel traps having a spread of jaws greater than 6½ inches may not be used for trapping fur animals or vermin. All traps must bear metal tag showing name and address of owner, must be visited once in every 36 hours, and at end of open season must be taken up or sprung. Unlawful to dig out fur animals; to drive them from holes or dens by use of smoke, explosives, or chemicals; to cut den trees; or to take fur animals by use of poison. Beaver houses and dams are protected, except under special permit. Unlawful to disturb traps of another or to remove fur animals therefrom.

Bag limits: One bear a season, or four to a camp or body of men.

Licenses: Nonresident, $15. Resident, $2. Issued by county treasurer. Minors under 16 may trap fur animals and vermin without a license. Licensee required to wear tag on middle of back. Resident citizen, members of family, and regularly hired help, residing on and cultivating land may hunt on such land, and, with consent of owner, on adjoining land without a license, during open season. Alien not permitted to hunt or kill any wild animal in State, except in defense of person or property. Trapper must report to board of game commissioners number of each kind of fur animals killed. Resident fur dealer, buying and selling in State, $5; interstate, $10. Nonresident fur dealer, $50.

Possession and sale: Bears may be possessed only during open season and first 30 days of close season. Bear and raccoon skins taken during open season may be possessed or sold at any time. Raw skins may be possessed during the open season and the first 15 days of close season.

Shipment and export: Skins of bears and raccoons legally taken may be shipped or exported at any time. Packages must be plainly marked to show contents, name and address of owner, and county in which taken. Nonresident licensee may take out one bear legally killed. No other restrictions on skins legally taken and possessed.

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[73] *Oregon:* Unlawful to hunt or trap fur animals on State game preserve.

[74] Unlawful to trap beavers in national forests. Beavers doing damage may be killed on own or leased property, but such killing must be reported in writing to the commission; hides of beavers so killed are the property of person killing them; other fur animals damaging property may be killed under permit of State game warden, but skins of animals so taken must be delivered to State game commission for disposition.

[75] *Pennsylvania:* May be shortened or closed by board of game commissioners. Fur animals, except beavers, may be killed or captured alive by landowners or tenants and their employees at any time to protect their growing crops.

[76] Bears may be killed at any time in defense of person or property.

[77] Under permit (no fee) from board, dogs may be used in hunting foxes and wildcats, Dec. 16 to Mar. 15.

Propagation: Fur-farming license, fee $1; license required to breed and sell ferrets, $25; to possess a ferret without breeding, $1.

Bounties: Wildcat, $15; gray fox, $4; weasel, $1. Goshawk (killed Nov. 1–May 1), $5. Affidavit on form supplied by game commission must accompany entire unmutilated skin of animal when presenting claim to board of game commissioners at Harrisburg.

RHODE ISLAND

Open seasons:[78]	*Dates inclusive*
Skunk	Nov. 1–Apr. 15.
Raccoon	Oct. 1–Feb. 1.
Muskrat, mink, otter	Nov. 1–Feb. 1.
Other fur animals	No close season.

Prohibited methods: Unlawful to spread poison outside of buildings, or to set wire snares, or to use steel traps with teeth or with spread over 6 inches, or choke traps with greater openings than 6 inches. Traps must be concealed so as not to endanger domestic animals and must be visited at least once every 24 hours.

Licenses: Hunting license required for trapping: Resident, $2.25; nonresident, $10.25; alien, $15.25; issued by town and city clerks. License not required of resident or his immediate family to hunt or trap on agricultural lands on which actually domiciled; nonresident owning real estate valued at not less than $500, and nonresident member of club incorporated for hunting or fishing purposes prior to January 1, 1909, which owns real estate assessed for taxation at value of not less than $1,000, may procure license at a fee of $2.25; nonresident guest of incorporated fox hunting club, $2.25 (authorizes fox hunting and is good for 6 days); licenses not issued to minors under 15. Written permission required to trap on inclosed lands of another.

Possession and sale: No restrictions on skins legally taken.

Shipment and export: No restrictions on skins legally taken.

Propagation: No legislation.

Bounties: Fox, $5; crow and certain hawks and owls, 25 cents; paid by State.

SOUTH CAROLINA

Open seasons:	*Dates inclusive*
Mink, muskrat, otter, skunk, and other fur animals	Nov. 28–Mar. 1.[79]
Raccoon,[80] opossum, fox[81] (hunting)	Sept. 1–Mar. 1.
Bear	No close season.

Prohibited methods: Hunting at night prohibited except for raccoon, opossum, or fox. Unlawful to shoot or trap foxes, to dig them out of the ground, or to push or drag them out of a tree or log. Unlawful to set, sell, make, or use a steel trap or any like device within State.[82] Use of deadfall prohibited.

Licenses: Hunting license required: Resident, county license, $1.10; State, $3.10; issued by county game warden and his agents; nonresident, $15.25; issued by county game warden. No license required of resident owners, tenants, their children, or, under written permission, their employees to hunt during open season on own lands. Consent of owner or manager required to hunt or trap on lands of another.

Possession and sale: No restrictions on skins of fur animals legally taken.

Shipment and export: Skins of fur animals must be tagged by State warden or deputy before being shipped or transported. Tag fees: Otter, red fox, $1; raccoon, gray fox, mink, 25 cents; skunk, 10 cents; opossum, muskrat, 5 cents. Packages containing furs for transportation must bear certificate of State warden or deputy that the tag required to be attached to each pelt has been properly attached and paid for. Persons, firms, or corporations shipping furs must make monthly report to county game warden of number of skins shipped or transported. Shipments must be labeled to show number and kind of skins in package and consignor and consignee. No other restrictions on skins of fur animals legally taken.

Propagation: No legislation.

Bounties: None paid.

SOUTH DAKOTA

Open seasons:[83]	*Dates inclusive*
Muskrat,[84] opossum	Dec. 15–Mar. 1.
Skunk[84]	Oct. 16–Mar. 1.
Beaver,[84] [85] otter, silver, black, or cross fox	No open season.
Other fur animals	No close season.

Prohibited methods: Unlawful to shoot or spear muskrats, or to destroy or molest muskrat houses, except that these may be opened without injury thereto for the purpose of placing traps therein during open season. No person may set or operate more than 75 traps at any one time.

Licenses: Resident only, $5; issued by director of game and fish and county treasurer. Fur dealer's license (no fee) issued by director of game and fish. Licenses not required of residents under 14, nor of landowners trapping on own lands during open season. Unlawful to hunt on cultivated or posted lands of another without permission of owner.

Possession and sale: Beaver skins must bear metal tag (fee, 50 cents) from director of game and fish. Raw furs may be possessed during open season and first 10 days of closed season.

Shipment and export: Permit from director of game and fish required to sell or ship beaver skins; unlawful to ship raw skins of protected fur animals during close season, whether taken or killed within or without State.

Propagation: Breeder's permit required to conduct a fur farm; fees, $1 for each silver, black, or cross fox, and $1 for each other kind of fur animal.

Bounties: Bounties not exceeding amounts specified paid by State on animals killed May 1 to August 31, as follows: Wolf (adult), $25; coyote or prairie wolf over 1 year old, $5; less than 1 year, $3; mountain lion, $10; fox, lynx, or bobcat, $3. Not paid on animals raised in captivity or for commercial purposes.

TENNESSEE[86]

Open seasons:[87]	*Dates inclusive*
All fur animals (season opens and closes at noon) (see exceptions)[87] [88]	Nov. 15–Feb. 15.

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[78] *Rhode Island:* Landowner may kill muskrat, raccoon, skunk, and mink on own land at any time.

[79] *South Carolina:* Wildcats may be killed without license at any time by officers of the law and by landowners upon their own holdings.

[80] Raccoons may be killed after July 15 by owners of crops that they are destroying.

[81] Trapping of foxes prohibited. Foxes may be hunted or chased with dogs on own or controlled land Sept. 1–Mar. 1, and foxes doing damage may be shot on own or controlled land at any time.

[82] Steel traps may be set within 200 yards of residence, or 25 yards of poultry house for protection of property.

[83] *South Dakota:* Season opens at noon and closes at noon.

[84] Skunks doing damage around buildings may be killed at any time, and, under permit from director of game and fish, muskrats or beavers damaging irrigation ditches, embankments, or public highways may be taken at any time.

[85] Director of game and fish may authorize trapping of beavers on public lands or game preserves.

[86] *Tennessee:* Trapping on State property, including lakes, prohibited. Foxes may be chased with hounds at any time.

[87] Fur animals may be taken on one's own land at any time, except in Chester, Crockett, Dyer, Fayette, Henderson, Henry, and Madison Counties, where they may be killed on own land only when a menace to crops or poultry. Foxes destroying poultry in Lawrence County or poultry or other livestock in Roane County, may be killed at any time. In Carter, Greene, Unicoi, and Washington Counties steel traps may be set within 100 feet of farm buildings on own or occupied premises.

[88] In Davidson County raccoons, opossums, skunks, and mink may be taken with gun or dog Oct. 1–Jan. 1.

Open seasons—Continued.

	Dates inclusive
Exceptions: In Carroll (trapping), Chester (trapping), Crockett, Dyer, Fayette, Hardeman, Henderson, Henry, Lauderdale, Madison, and Weakley (trapping) Counties	No open season.[89]
In Madison County, opossum	Oct. 1–Jan. 1.
In Dickson County, fox, mink, and weasel	No close season.
In Bledsoe, Meigs, Rhea, and Roane Counties, fox	No open season.
In Carter, Greene, Unicoi, and Washington Counties, mink, muskrat	Nov. 15–Feb. 15.[89]
In Franklin County, opossum	Nov. 1–Feb. 15.
In Giles and Houston Counties, fox	No close season.
In Hardin County, raccoon	No open season.
In Haywood County, fur animals	Oct. 15–Jan. 15.
In Lawrence County, fox (1930)	Jan. 1–Feb. 15.
In Williamson County, fur animals	Nov. 1–Feb. 1.[89]

Prohibited methods: Steel traps must be placed at least 12 inches within the entrance to a hole, cave, den, or hollow log. Use of snares and deadfalls prohibited.

Licenses: None required. Written consent required to trap on lands of another. Traps must be inspected within each 36 hours, and captured animals removed; does not apply to trapping wildcats in Lauderdale County.

Possession and sale: No restrictions except that live foxes or skins of foxes taken in Bledsoe, Meigs, and Rhea Counties may not be purchased or sold.

Shipment and export: Prohibited. Skins of protected fur animals may only be carried out in personal possession of holder of a hunting license.

Propagation: No legislation, except in Rutherford County, where $10 license from State game warden is required.

Bounties: None paid.

TEXAS

Open seasons:[90]

	Dates inclusive
Bear (game animal)	Nov. 16–Dec. 31.
Beaver, otter, fox (see exception)	No open season.
Exception: Foxes, west of San Antonio and Cibola Rivers and western boundary of Guadalupe, Caldwell, Bastrop, Lee, Burleson and Brazos Counties, Brazos River, and western boundary of Jack and Clay Counties (except in Hays, Milam, Williamson, and Young Counties, no open season)	No close season.
Muskrat	Nov. 16–Mar. 15.
Other fur animals	Dec. 1–Jan. 31.

Prohibited methods:[91] Beds, nests, and breeding places of muskrats protected, and muskrats may only be taken by trapping, except on own land, where they may be taken at any time by any means. Headlight, hunting lamp, or other artificial light prohibited in certain areas. Unlawful to trap muskrats on posted or inclosed lands of another without consent of owner.

Bag limits: One bear a season.

Licenses: Resident, $1; nonresident, $50. License not required of resident landowners, tenants, and their children on own land. Fur buyer: Resident, $2.25; nonresident, $25. Fur dealer: Resident, $5; nonresident, $100. Issued by game, fish, and oyster commissioners, deputies, or county clerks. Consent of owner necessary to trap on inclosed land of another. Fur buyers and dealers must make sworn monthly report of skins purchased or shipped out of State.

Possession and sale: Possession during close season prohibited, except persons handling skins or pelts of fur animals allowed 10 days after close of season to dispose of them; no restriction on possession for personal use of skins taken during open season. Fur tax, mink and raccoon skins, 5 cents each; other skins 1 cent each, such tax to be paid by dealer, or by trapper shipping his own catch within or out of State. Unlawful to purchase, on land of another, pelts of muskrats taken or trapped on such land, except from the landowner or his agent.

Shipment and export: No restrictions on skins legally taken or obtained and on which tax has been paid. Shipments must be marked with tag from commissioner or deputy to show names and addresses of consignor and consignee, initial point of billing, and number and kind of skins in shipment, and duplicate of tax returned to commissioner.

Propagation: Permit must be obtained from game, fish, and oyster commission to trap or transport wild animals for propagation.

Bounties: May be paid by commissioner's court of McCulloch, San Saba, Lampasas Counties on wolves, wildcats, and other predatory animals, and in Clay, Archer, Baylor, Young, Wise, Wilbarger, Wichita, Coryell, Callahan, Jackson, Eastland, Wharton, Taylor, and Brazos Counties the commissioners' court may pay bounty of $5 each on panthers, wolves, wildcats, and 10 cents each on jack rabbits.

UTAH

Open seasons:[92]

	Dates inclusive
Bear	No close season.
Beaver,[93] otter	No open season.
Mink, muskrat,[94] marten, raccoon	Oct. 15–Dec. 15. Feb. 15–Apr. 1.
Other fur and predatory animals	No close season.

Prohibited methods: Use of silencer on gun and discharge of firearm from automobile or within 50 feet of a public highway prohibited. Unlawful to disturb muskrat houses or dens, or to set traps within 25 feet thereof.

Licenses: Resident citizen, $5. Issued by State fish and game commissioner or deputy, county clerk, or deputy or authorized agent. Not issued to minors under 16. Unlawful to disturb or remove traps of licensed trappers on public domain or on lands where they have permission to trap. Aliens other than homesteaders are not permitted to hunt or trap.

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[89] In Crockett and Hardeman Counties residents may hunt wild animals at night with dogs Nov. 1–Feb. 1, and Oct. 15–Mar. 1, respectively, and in Crockett County residents under 16 may trap wild animals with one legal device Nov. 1–Feb. 1. In Carroll County fur animals may be taken Nov. 15–Feb. 15 with guns and dogs only. In Carter, Greene, Unicoi, and Washington Counties mink and muskrat traps must be set under water; raccoon, opossum, and skunk may be caught by use of dogs Oct. 15–Jan. 15, and fox may be chased with dogs at any time. In Sevier County foxes may only be taken by use of dogs, or by traps set 10 inches within a hole or underground. In Williamson County raccoon, opossum, skunk, and mink may only be taken with gun or dog.

[90] *Texas.* Trapping wild animals prohibited in Limestone County.

[91] Unlawful to use steel trap, deadfall, snare, or any other mechanical device other than a gun or pistol in taking fur-bearing animals in Panola, Shelby, Rusk, Nacogdoches, Cherokee, Hardin, Angelina, Harris, San Augustine, Polk, San Jacinto, Trinity, Tyler, Liberty, Anderson, Sabine, Brazos, Madison, Grimes, and Montgomery Counties.

[92] *Utah:* Commissioner may shorten or close seasons on fur animals, or further restrict the number that may be taken, where necessary to afford sufficient protection to any species.

[93] When beavers are destroying property, State fish and game commissioner may grant permit to trap them, but hides of animals so taken must be delivered to and sold by commissioner, who shall recompense for trapping in not more than half the proceeds from sales.

[94] Property owners may trap muskrats doing actual damage to dams, ditches, or watercourses in sufficient numbers to insure protection to such property.

Possession and sale: Skins of fur animals legally taken may be possessed and sold at any time, except that skins of beavers, which may be taken only when doing actual damage to property under permit of the commissioner, must be turned over to the commissioner to be sold by him. Possession of beaver skins prohibited, except by a permit holder, unless tagged by commissioner. Green pelt or carcass of fur animal may not be possessed except during open season and 15 days thereafter.

Shipment and export: Shipment and export of furs legally taken and possessed permitted at any time.[93] (See "Possession and sale.") Skins of beavers taken under permit of the commissioner may only be shipped by the permittee to the commissioner for sale. Shipment or export of beaver skins prohibited, unless such skins are tagged by the commissioner.

Miscellaneous: Use of flesh of game animals or birds as trap bait for fur animals prohibited.

Propagation: Permit (no fee) from commissioner required to propagate fur animals, but such animals held under permit may not be killed during close season.

Bounties: Wolf, mountain lion, cougar, $15; bear, $10; coyote, $6; lynx, bobcat, $3.

VERMONT

Open seasons:[95]	*Dates inclusive*
Muskrat (see exceptions)	Nov. 1–Apr. 20.
Exceptions: On shores of Lake Champlain in Rutland County; Poultney River below Carvers Falls, and shores of Lake Memphremagog in Orleans County	Jan. 1–Apr. 30.
Waters and shores of Lake Champlain in Addison and Chittenden Counties; Shelburne Pond and Hinesburg Pond (Lake Iroquois) in Hinesburg; banks and waters of La Platte River in Shelburne; East Creek, Dead Creek, Lemon Fair, Little Otter Creek, Lewis Creek, Leicester River, or their tributaries, or Otter Creek in Addison County	Jan. 1–Apr. 20.
Mink (see exception), raccoon, fox (except Grand Isle County, no close season), otter (see exception), marten, skunk	Nov. 1–Feb. 15.
Exception: Mink and otter, on shores of Lake Champlain in Rutland County; Poultney River below Carvers Falls; shores of Lake Memphremagog in Orleans County	Jan. 1–Apr. 30.
Beaver, fisher cat	No open season.

Prohibited methods: Use of set guns, snares, and poisons prohibited; bear traps must be carefully safeguarded, and visited once in 48 hours. Unlawful to open or destroy a muskrat house or to place a trap therein or at its entrance. Unlawful to take skunks, raccoons, or foxes from holes or dens by cutting, digging, smoking, trapping, or snaring, or use of chemicals or any mechanical device.

Licenses: Resident, $1; nonresident, $50; issued by town clerk. Owners of farmlands and their resident minor children or tenants may take fur animals on own lands during open season without a license. License not required of person under 15 to trap, and not issued to person under 16 without written consent of parents or guardians. Nonresident citizen owning improved real estate appraised at not less than $1,000 upon which he pays taxes may obtain a resident license. Persons trapping on inclosed lands of another must, within 12 hours, inform owner of location and number of traps and must visit traps at least once in 24 hours.

Possession and sale: Possession of fur animals during close season prohibited, but the fur or skins of animals legally taken may be possessed, bought, or sold at any time.

Shipment and export: Packages containing fur animals or parts thereof delivered to a common carrier for transportation must be tagged to show number and kind of such animals or skins therein, names of consignor and consignee, station from which shipped, and destination. A person required to have a license must also show number of his license on shipping tag. No other restrictions on skins legally taken and possessed.

Propagation: State fish and game commissioner issues special permits for propagating fur and game animals (fee, $2 and expense of tagging). Animals bred on fur farms may be sold and transported alive at all times when bearing identification tags prescribed by commissioner.

Bounties: Towns pay $10 bounty on bay lynx or bobcat and $1 on rattlesnake.

VIRGINIA

Open seasons:[96]	*Dates inclusive*
All fur animals[97] (trapping on lands of another) (see exceptions, and see local laws)	Nov. 15–Feb. 28.
Exceptions: In Rockbridge County, fur animals (1932)	No open season.[98]
In King George, Lancaster, Northumberland, Richmond, and Westmoreland Counties, fox (hunting only—may not be trapped at any time)	Sept. 1–Mar. 14.[99]
In Frederick County, fox (shooting)	Oct. 1–Jan. 31.[99]
In Middlesex County, fox (hunting only—may not be shot at any time)	Oct. 1–Mar. 31.
Local laws for trapping or taking fur animals:	
In Halifax County, fur animals (except mink and weasel, Nov. 15–Feb. 28, and fox, Sept. 16–Mar. 14)	No open season.[98]
In Amelia and Nottoway Counties, fur animals (except fox, no open season)	Sept. 16–Mar. 14.
In Lee County, fox	Mar. 14, 1931.[99]
In Buchanan County, raccoon	Nov. 15–Jan. 31.
In Essex, Charles City, James City, New Kent, Warwick, and York Counties, muskrat	Dec. 15–Mar. 31.
In Lunenburg County, fox, raccoon, muskrat, opossum, beaver, otter	Sept. 16–Mar. 14.[99]
In Henrico, Chesterfield, New Kent, Charles City, and James City Counties, raccoon, opossum	Oct. 15–Mar. 14.[99]

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[95] *Vermont:* Fur animals may be killed at any time to protect one's own property, but such killing must be reported to commissioner within 84 hours and pelts held for official inspection. Disposition of pelts so taken prohibited except under certificate of commissioner.

[96] *Virginia:* Commission of game and inland fisheries may alter provisions of general law on seasons, methods of taking, etc. Season applies to trapping on lands of another, which is lawful only with written permission of owner, which permission the trapper must have on his person when trapping. In counties where general law applies fur animals may be taken on own land at any time.

[97] Bear, beaver, fisher, mink, muskrat, opossum, otter, raccoon, skunk, and weasel may be hunted with guns and dogs Oct. 1–Jan. 31, except in counties where a shorter season is prescribed by county commissioners or by local law.

[98] May be taken on own or leased land at any time.

[99] May be taken at any time when destroying property.

Open seasons—Continued.

	Dates inclusive
Local laws for trapping or taking fur animals—Continued.	
In Charlotte County, fox (hunting with dogs)	Sept. 15–Mar. 14.
In Patrick County, raccoon, opossum	Oct. 15–Mar. 14.
In Patrick County, fox (gray)	Sept. 15–Mar. 14.
In Madison and Orange Counties, fox	Nov. 1–Dec. 31.
In Albemarle,[1] Amherst, Nelson,[1] and Spotsylvania Counties, fox	Nov. 1–Nov. 30.[2]
In Loudoun and Fauquier Counties, fox	Sept. 1–Mar. 31.[99]
In Campbell, Culpeper (except in Jefferson magisterial district, fox, Nov. 1–Dec. 31), Pittsylvania, Rappahannock, and Tazewell Counties, fox	Sept. 15–Mar. 14.[99]
In Greene County, fox (shooting prohibited)	Nov. 15–Feb. 28.[2]

Prohibited methods: Unlawful to take muskrats in tidewater sections of State from half an hour after sunset to half an hour before sunrise, except by traps. Traps must be marked with name and address of trapper. Traps must be inspected once in each 36 hours. Unlawful to set steel traps in Southampton County until 1932, except by landowners in protection of property.

Licenses: Combined hunting, fishing, and trapping: Nonresident, $15.50; alien, $15.50 (alien owner of real estate resident for five years, same as resident). Enlisted or commissioned personnel of Army, Navy, or Marines stationed in Virginia may obtain licenses for same fees as residents. Resident: State, $3; county, $1. Ninety cents may be allowed on county license when exchanged for State license. Issued by clerks of circuit and corporation courts. Licensee required to wear button issued with license. License not required of residents to hunt foxes with hounds. Residents, nonresidents, and aliens, and their husbands, wives, or children may hunt on own land during open season without a license. Tenant, under written consent of owner or landlord, may hunt without license during open season on lands on which he resides. Written permission is required to trap or hunt on lands of another, except chasing foxes with hounds where chase begins on other lands, and except uninclosed mountain lands west of Blue Ridge, not used for cultivation, except in Giles, Bland, Bath, and Highland Counties.

Possession and sale: No restrictions on skins legally taken, except that sale of red or gray fox is prohibited during close season in Henry County.

Shipment and export: No restrictions on skins legally taken.

Propagation: License required (fee, $25) to raise game or fur animals.

Bounties: Weasel, $1; sharp-shinned and Cooper's hawks, goshawk, great horned owl, 50 cents each; crow (if killed April 1 to September 30), 15 cents each; paid by boards of supervisors.

WASHINGTON

Open seasons:[3]

Beaver	No open season.[4]
Other fur animals (open season fixed by county game commissions).[5]	

Prohibited methods: No steel trap larger than No. 3 may be used unless a notice in the English language on a large placard is placed above the trap. Unlawful to take fur animals with a gun larger than 10 gauge, or to disturb or remove traps of a licensed trapper. Traps must be marked with the name and address of owner.

Licenses: Resident citizen, $5 (county); fur dealer, $10; issued by county auditor. License not required of landowners and leaseholders trapping on own premises nor of minors under 16. Dealers required to make quarterly reports of transactions and trappers to make annual report of number and kind of animals taken.

Possession and sale: Beaver skins obtained without State, if inspected and tagged or stamped (tag, 10 cents) by supervisor of game and game fish or county game commission, may be possessed or sold at any time. Other furs legally taken or coming from without State may be possessed, sold, and transported at any time.

Shipment and export: Skins of fur animals legally taken and possessed may be shipped at any time.

Propagation: Breeder's license (fee, $20; renewal, $10) required.

Bounties: Paid by State. Counties are permitted to pay bounties on mountain lion or cougar, lynx or wildcat, coyote, timber wolf, bear, red squirrel, and in the Columbia River district on seal or sea lion. Hair seal, $3 (paid by State).

WEST VIRGINIA

Open seasons:[6]	*Dates inclusive*
Skunk, raccoon, opossum	Nov. 1–Jan. 31.
Red fox, in Brooke, Cabell, Fayette, Harrison, Kanawha, Lewis, Mason, Mingo, Morgan, Pleasants, Putnam, Ritchie, Summers, Taylor, Upshur, Wetzel, Wirt, Wood, and Wyoming Counties	Dec. 1–Jan. 31.
In rest of State	No close season.
Beaver, otter	No open season.[7]
Muskrat	Nov. 1–Feb. 28.
Other fur animals	No close season.

Prohibited methods: Unlawful to set a steel or spring bear trap on land of another or on own land unless inclosed by a fence. Unlawful to hunt wild animals, except those that take refuge in trees, with a spot or jack light or other artificial light, or to cut down any tree in which animals den or take refuge for the purpose of capturing such animals.

Licenses: Hunting license required to take fur animals: Resident, $1; nonresident, $15; issued by county clerk. Resident landowner, his resident children, or tenants may hunt or trap during open season on own land without a license. License not required of minors under 15. Express permission of owner or tenant required to set or maintain a snare or trap upon land of another. Licensee must wear tag.

Possession and sale: No restrictions on skins legally taken.

Shipment and export: No restrictions on skins legally taken.

Propagation: Permit (fee, $1) required for taking fur animals for propagation.

Bounties: Game, fish, and forestry commission may pay bounties on predatory wild animals.

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[99] See footnote 99 on p. 23.

[1] Unlawful to take or dig foxes from dens or holes in Albemarle and Nelson Counties between Mar. 31 and July 31.

[2] May not be shot except to protect property.

[3] *Washington:* Communicate with county game commission at county seat or supervisor of game and game fish, Box 384, Seattle. Fur animals may be trapped by landowners or tenants when destroying crops, domestic animals, or poultry.

[4] State supervisor of game and game fish may issue permits to take beaver in State.

[5] County game commission may remove or kill game and fur animals doing damage to property.

[6] *West Virginia:* A landowner, his agent, or tenant may hunt or kill fur animals, except raccoons, opossums, muskrats, beavers, and otters, on his own lands at any time.

[7] Commission may open season on beavers and otters.

WISCONSIN

Open seasons:	*Dates inclusive*
Beaver,[8] marten, fisher	No open season.
Otter, mink (see exception)	Nov. 15–Mar. 1.
Exception: On Horicon marsh in Dodge County, mink	No open season.
Muskrat, south of the north line of Buffalo, Trempealeau, Jackson, Wood, Portage, Waupaca, Outagamie, Brown, and Kewaunee Counties (see exceptions) (open in even, closed in odd years)	Mar. 1–Apr. 10.
Exceptions: In Calumet, Fond du Lac, Outagamie, Waushara, and Winnebago Counties, and townships of Royalton, Mukwa, Weyauwega, Caledonia, and Fremont in Waupaca County (annual season)	Oct. 25–Apr. 1.
On Horicon marsh in Dodge County	No open season.
In remainder of State (open in even, closed in odd years)	Mar. 1–Apr. 25.
Raccoon	Nov. 1–Dec. 31.
Skunk, in all counties south of the north line of Buffalo, Trempealeau, Jackson, Wood, Portage, Waupaca, Outagamie, Brown, and Kewaunee Counties	Nov. 1–Jan. 31.
In rest of State	Oct. 15–Jan. 15.
Fox (silver, silver-black, black), bear	No open season.
Other fur animals	No close season.

Prohibited methods: Unlawful to take mink or muskrat with the aid of spear, gun, or dog; to disturb or molest muskrat houses, beaver houses, or beaver dams, or to molest or disturb raccoon or skunk dens or trees. Unlawful to set trap within 500 feet of beaver house or dam. Unlawful to use poison bait, poison gas, dynamite, or other explosive in taking wild animals.

Licenses: Resident, $1, issued by conservation commission or county clerks. Each trap must be tagged, fee 5 cents. Report required from licensed trapper on or before June 1 of each year. Nonresidents not permitted to trap; alien not permitted to hunt. Written consent of owner or occupant required to trap minks or muskrats on agricultural lands of another.

Possession and sale: Possession of green skins of fur animals permitted only during open season and first five days of close season; possession prohibited of the skin of a mink or muskrat which shows that the animal has been shot or speared. No other restrictions on possession and sale of skins legally taken.

Shipment and export: No restriction on skins legally taken. Shipments of furs must be marked to show number and kind of hides, name and address of shipper, and number of his trapping license.

Propagation: Under license and supervision of commissioner, beaver, muskrat, skunk, otter, mink, raccoon, fisher, or marten may be taken and transported for propagation within State. Special licenses required to conduct fur farms. Breeders have same rights in silver, silver-black, and black foxes as domestic animals. Unlawful to trespass on posted fox farm.

Bounties: Wolf cub taken between March 1 and November 1, $4; mature wolf killed at any time, $30; fox, $2; paid by State. County boards may offer bounty on crow, hen hawk, pocket gopher, streaked gopher, groundhog or woodchuck, English sparrow, blackbird, or rattlesnake.

WYOMING

Open seasons:	*Dates inclusive*
Beaver	No open season.[9]
Otter, fisher, marten, mink, fox, raccoon	Nov. 16–May 1.
All other fur animals	No close season.

Prohibited methods: Unlawful to trap bears.

Licenses: Resident citizen, $10; nonresident citizen, $50. License not required of persons under 17, nor for trapping predatory animals. Permit for trapping in State game preserves and national forests (fee, $1) issued by State game and fish commissioner. Employees of Federal Government do not require permit to trap predatory animals. Taxidermist, $10. Fur buyer, $10. For bear: Nonresident, $25, limit, 3 bears; resident, $1; issued by commissioner. Dog license, $1 (required for each dog used in hunting bears or predatory animals in national forests). Permission of owner required to hunt or trap on inclosed lands of another.

Possession and sale: Skins of beavers killed when doing damage to real estate may be possessed when duly tagged by commissioner and affidavit is furnished the commissioner by owner of the real estate showing damage and number of beavers killed, and upon payment of $1.50 for each beaver tag.

Shipment and export: Beaver hides must be tagged by commissioner before being shipped or transported.

Miscellaneous: Use of flesh of game animals or birds as trap bait for predatory animals prohibited.

Propagation: Beavers and other fur animals may be taken for propagation under a $10 permit, but animals so taken must be kept three years before being killed or sold.

Bounties: Bobcat, coyote, gray or black wolf, $3; mountain lion, $15.

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[8] *Wisconsin:* If beavers damage property, they may be captured and removed under permit and direction of State conservation commission; skins of animals that are killed in taking must be delivered to conservation commission. Owners or lessees of dams, under permit of conservation commission, may destroy at any time muskrats to protect such dams or levees, but may not sell, barter, or give away skins of such animals killed during close season.

[9] *Wyoming:* If beavers damage real estate, owner thereof may kill them, but must furnish State game and fish commissioner with affidavit describing real estate and showing damage and number killed. Skins of animals so taken must be tagged immediately (fee, $1.50 each).

LAWS OF CANADA

ALBERTA

Open seasons:[10]	*Dates inclusive*
Bear (except cubs or bear with cub)	Sept. 1–June 14.
Fox[11]	Nov. 1–Feb. 28.
Mink, fisher, marten	Nov. 1–Mar.31.[12]
Otter	Nov. 1–Apr. 30.
Muskrat,[13] south of North Saskatchewan River	No open season.
North of Township 90	Mar. 16–May 15.
In rest of Province	Mar. 15–Apr. 16.
Open seasons—Continued.	*Dates inclusive*
Beaver[12]	No open season.[13]
Other fur animals	No close season.

Prohibited methods: Unlawful to use poison for taking fur animals; or to destroy, partially destroy, or to leave open any muskrat or beaver house or beaver dam, or, except under permit, spear or shoot muskrats.

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[10] *Alberta:* Lieutenant governor in council may change close season on fur animals.

[11] Unlawful to trap fox for export.

[12] Unlawful to destroy a beaver dam unless authorized to do so by lieutenant governor in council, who may also authorize the killing of beavers or other fur animals when such killing is deemed to be in the public interest.

[13] Lieutenant governor in council may declare open seasons locally on beavers and muskrats.

Licenses: Trapping: $2 (issued to resident only); issued by minister of agriculture. License not required of farmer or member of his family while actually residing with him upon his farm. Consent of owner or occupant required to trap on inclosed or cultivated lands of another. Permits to trap on game or forest reserves may be granted under regulations of lieutenant governor in council. Taxidermist, $5. Dealer in furs and skins of protected animals at a specified place of business, or within 1 mile thereof: Resident of a city, $25; resident outside of a city, $10; nonresident, $100. Traveling license issued to holder of a dealer's license or his manager upon payment of fee of $15. Traveling buyer: Resident, $25; nonresident, $100. Nonresident buying wholesale from licensed dealers, $5 (good for 10 days only). Licensee must make semiannual reports to department of agriculture. License to sell skins by tender or auction, fee, $25. Issued by minister or agents.

Bag limits: One bear of each species a season.

Possession and sale: No restrictions on prime skins legally taken and possessed.

Shipment and export: Export of furs and skins prohibited except under permit from minister. No furs or skins on which royalty has not been paid may be exported, and a special permit from the minister is necessary to ship out unprime skins. Export of live wild foxes prohibited.

Propagation: Manager of fur farm required to make reports January 1 and July 1 of each year. Export of live animals from fur farms allowed only on permit from the minister of agriculture. Permit, with fees, required to export live muskrat, mink, fisher, marten, otter, or beaver, whether raised on a fur farm or otherwise (orders in council).

Bounties: Timber wolves, male, $10, female, $20. Prairie wolf taken between April 30 and September 1, $2.

BRITISH COLUMBIA

Open seasons:[14]	*Dates inclusive*
Eastern district:[15]	
Beaver, muskrat, otter (see exception)	Mar. 1–May 15.
Exception: In that portion of district south and east of a line from Birken, following Pacific Great Eastern Railway to Lillooet railway station, thence east to Canadian National Railway at Ashcroft, thence following Canadian National Railway north and east to the Alberta line	Mar. 1–Apr. 15.
Other fur animals	Nov. 1–Feb. 28.
Bear (hunting) (except white or Kermodei bear)	Sept. 1–June 30.
Western district:[15]	
Beaver, muskrat, otter (see exception)	Mar. 1–Apr. 15.
Exception: Beaver, muskrat, on Vancouver Island	No open season.
Other fur animals	Dec. 1–Feb. 28.
Bear (hunting) (except white or Kermodei bear)	Sept. 14–June 30.

Prohibited methods: Bears may not be trapped. Unlawful to poison fur animals except that farmers and poultrymen may protect own stock; to destroy muskrat or beaver houses, except under permit to prevent damage on diked or agricultural lands; or to hunt fur animals at night.

Bag limits: Two grizzly bears and three of any other species a season.

Licenses: Trapping: Resident, British subject, $10; nonresident or resident alien not permitted to trap; nonresident general hunting license, fee $25, and additional fees of $15 to $25 for each bear killed. License not issued to boys under 18 without written consent of parent or guardian. Issued by provincial game commissioner or authorized agent. Licensee must wear badge. Permission of owner required to trap on inclosed, cleared, or cultivated land of another. Mainland trappers must register trap lines, and licensed trapper who first occupies a trap line not later than 15 days after the beginning of any open season for trapping is protected against other trappers. Unlawful to touch or interfere with traps set by a licensed trapper. License must be returned within two months after it expires, with a statement of number of fur animals of each kind taken. Fur dealer: Resident, $25 (does not apply to licensed trapper selling skins taken by himself); nonresident or his agent, $200. License required for each place of business. Fur dealer must make verified report every three months, showing number and kind of skins purchased and date of transactions. Taxidermist, $5; tanner, $5. Provincial game commissioner may grant free permit to buy furs at wholesale from licensed fur dealers or at public auction.

Possession and sale: Bear (except white or Kermodei bear) may be sold in eastern district from September 1 to June 30, and in western district from September 15 to June 30. Unlawful to sell pelts taken during close season or to possess unprime furs. Possession of pelts of fur animals allowed only during open season, and for two months thereafter (three months, north of fifty-second parallel), except under special permit from provincial game commissioner. Royalties must be paid on all furs exported or shipped to a tanner within Province.

Shipment and export: Export of pelts of fur animals allowed only under special permit of provincial game commissioner. Packages must be prepared so that they may be easily opened for examination, or labeled with a full description of contents, and names and addresses of the consignor and consignee, and accompanied by export permit.

Propagation: A permit from the provincial game commissioner is required to propagate fur-bearing animals or to take them for breeding purposes. Breeder must keep a record of transactions as to purchases and sale of stock, which record must be open to inspection of any game warden, and must make verified report to provincial game commissioner on or before August 31. Live animals and birds may be exported only under permit; and a permit is required to take foxes or other fur animals in close season.

Bounties: Panther, $40; timber wolf, $25; coyote, $2 (if not less than one week old). (Rates fixed from time to time by lieutenant governor in council.)

MANITOBA

Open seasons:[16]	*Dates inclusive*
North of fifty-third parallel—	
Fisher or pekan, sable, marten, mink	Nov. 1–Mar. 31.
Otter	Nov. 1–Apr. 30.
Muskrat	Mar. 15–May 15.
Fox, lynx	Nov. 1–Feb. 28.
Beaver	No open season.
South of fifty-third parallel—	
Fisher or pekan, sable, marten, mink	Nov. 1–Mar. 31.
Otter, beaver[17]	No open season.
Muskrat	Mar. 15–Apr. 30.
Fox, lynx	No close season.

Prohibited methods: Use of poison or dog in taking or hunting fur animals is prohibited. Unlawful to shoot or spear muskrats or to destroy muskrat houses. Beaver houses and dams protected, except under permit to protect property.

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[14] *British Columbia:* Seasons on fur animals, fixed annually by lieutenant governor in council, may be obtained from provincial game commissioner, Vancouver.

[15] Western district includes that portion of Province west of summit of Cascades and south of Atlin electoral district. Eastern district includes rest of Province.

[16] *Manitoba:* Lieutenant governor in council may shorten current open season on fur animals. Trapping in provincial game preserves prohibited, except in Nos. 14, 15, and 19.

[17] Game commissioner may take necessary steps to prevent beaver damage, but no beaver dams may be disturbed between Oct. 1 and Apr. 1.

Licenses: Trapping: Resident, $2; nonresident Canadian citizen, $50; nonresident alien, $200; issued by minister of agriculture and immigration. Permission of owner required to trap on cultivated or inclosed lands of another. Licensee must return his license and make a report during month of June, showing number of each kind of animals taken. Fur trading: Resident traveling fur buyer, $25; resident raw fur merchant, or dealer, $10; resident traveling agent, $10; issued by minister. Licensees are required to keep record and to make monthly reports of furs handled. Fur dressing and tanning, $10; issued by minister. Licensee must keep records and report to chief game guardian on or before 10th of each month the number of royalty pelts handled and name and address of person forwarding or delivering the skins. Royalties of varying amounts must be paid on undressed skins or pelts of fur animals, except those imported or ranch bred.

Possession and sale: Possession of unprime skins prohibited. Unlawful to purchase or sell skins of muskrats that have been speared or shot. Any person purchasing or acquiring pelts from a trapper must have license or permit, and must ascertain that trapper holds proper trapping permit and at the same time record his name and number of his permit. Unlawful to purchase, barter, or trade pelt of a fur animal taken during the close season (does not apply to imported skins). No other restrictions on skins legally taken.

Shipment and export: Export prohibited of unprime skins or skins on which royalty is payable unless such shipment is accompanied by a permit procured from minister and has attached a declaration of number and kinds of skins contained. Shipment or removal from Province prohibited except by express or mail. No other restrictions on skins legally taken. Export prohibited of live protected animals (except ranch-bred animals) except under permit from minister of agriculture and immigration (permit must accompany shipment to destination); fees, for black or silver fox, $100; for other fox, $15; for otter, $25; for beaver, $5; for mink, fisher, or marten, $1; for muskrats, $2 a dozen or fraction thereof.

Propagation: License (fee, $5) must be obtained from minister to operate a fur farm. Licensee, on or before the first days of January and July, must make verified reports showing number, species, age, and sex of animals on hand, from whom procured, and number that have died during previous 6 months, with cause of death.

Bounties: Timber wolf,[18] $5; other wolf, $2; half is refunded to municipality by provincial treasurer.

NEW BRUNSWICK

Open seasons:	*Dates inclusive*
Otter, fisher, marten, sable	Nov. 1–Mar. 31.
Mink, fox, raccoon	Nov. 1–Feb 28.
Muskrat (see exception)	Mar. 25–May 1.
Exception: In Carleton, Gloucester, Kent, Madawaska, Northumberland, Restigouche, and Victoria Counties	Mar. 25–May 25.
Beaver	No open season.[19]
Other fur animals	No close season.

Prohibited methods: Unlawful to take fur animal by use of poisons, with aid of hounds, or with gun equipped with silencer; to dig out foxes from their homes or earth burrows; or to shoot muskrats.

Licenses: Fur dealers:[20] Persons domiciled in Province, $10; all other persons, $50. Fur dealers must furnish minister with written declarations showing their names and addresses, location of warehouses, shops, posts, or caches where skins are to be stored and places from which skins will be shipped out of Province, and must make monthly reports of operations. Issued by minister of lands and mines.

Possession and sale: Possession prohibited of furs on which royalties, as fixed by lieutenant governor in council, have not been paid; possession of green skins or carcasses of protected fur animals in close season prohibited.

Shipment and export: Skins legally taken, possessed, stamped, tagged, and on which royalty has been paid, may be exported under permit from minister. Permit from minister required to export live fur animals.

Propagation: Permits to capture wild fur animals for propagation within Province may be obtained from minister, who fixes fee for such permit.

Bounties: Wildcat, bear, $5.

NORTHWEST TERRITORIES[21]

Open seasons:[22]	*Dates inclusive*
Mink, fisher, marten	Nov. 1–Mar. 15.
Beaver (see exception)	Jan. 1–May 15.
Exception: In Mackenzie district	No open season.[23]
Otter, north of Arctic Circle	Nov. 1–May 15.
South	Nov. 1–Apr. 30.
Muskrat, north of Arctic Circle	Mar. 1–June 15.
South	Nov. 1–May 15.
Fox, lynx, north of Arctic Circle	Nov. 1–Mar. 15.
South	Nov. 1–Feb. 28.

Prohibited methods: Unlawful to use automatic rifles, revolvers, shotguns, or dogs or poison in taking fur animals, or to destroy or injure any muskrat or beaver house or beaver dam.

License: Trapping: Resident, $2; nonresident British subject, $75; other nonresident, $150. Fur dealer or trader or trafficker in furs: Resident, $5; nonresident British subject, $150; other nonresidents, $300. Fur farm, $5 (renewal, $2). Issued by director of Northwest Territories. License not required of native-born resident Indian, Eskimo, or half-breed. Licensed trappers, and Indians, Eskimos, and half-breeds must report to nearest game officer number of fur animals taken. Permit, fee $1, of minister required to establish trading post.

Possession and sale: Licensed trapper may sell or trade skins of animals he has legally taken. Possession of unlawful or low-grade furs prohibited. No restrictions on other skins legally taken.

Shipment and export: Furs legally taken may be exported under permit of minister if stamped or sealed by permit officer, and, after January 1, 1930, upon the payment of royalties.

Propagation: Fur-farm license, fee $5 (renewal, $2). Fur animals may be captured for propagation. Fees: $2 for each animal, except muskrat (25 cents each) taken. Limit, 100 muskrats, 6 of each other species. Export of such animals prohibited except under permit. Fees: $10 (20 muskrats, and 50 cents for each additional muskrat; limit 100); other fur animals $10 each, limit 6 of each species.

Bounties: Timber wolf, $30 (skin must be surrendered).

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[18] Poison may not be used to capture wolves for bounty.

[19] *New Brunswick:* Expires Oct. 1, 1930.

[20] License requirements and other provisions of act do not apply to hunter or trapper who is a British subject domiciled and residing in Province, who actually hunts, provided he sells his furs to a person domiciled in Province.

[21] *Northwest Territories* means the northwest territories formerly known as Rupert's Land and the Northwestern Territory (except such portions thereof as are included in Provinces of Ontario, Quebec, Manitoba, Saskatchewan, and Alberta, and Yukon Territory), together with all British territories and possessions in North America and all islands adjacent thereto not included within any Province, except Dominion of Newfoundland and its dependencies.

[22] Trapping prohibited in Peel River, Yellowknife, Arctic Islands, and Slave River Preserves, which have been reserved as hunting and trapping grounds for native Indians, Eskimos, and half-breeds.

[23] Expires Oct. 1, 1931.

NOVA SCOTIA

Open seasons:[24]	*Dates inclusive*
Beaver, marten, fisher	No open season.
Bear, wolf, wildcat	No close season.
Other fur animals	Nov. 15–Jan. 31.

Prohibited methods: Unlawful to take any protected fur animal by use of poison; to damage or molest a beaver dam or house or a muskrat house or to set snare or trap within 25 feet of the latter.

Licenses: Trapping: None required of resident; nonresident, $50; issued by minister of lands and forests. Fur buyers: Nonresident, $100; resident, $25; issued by minister of lands and forests. Fur buyer must keep record and make monthly report of number of skins bought or sold, together with names and addresses of parties from whom purchased or to whom sold. Taxidermist, $5. Royalties of varying amounts must be paid on all furs, except bear, wolf, and wildcat.

Possession and sale: Unlawful to possess or sell green hide of any beaver, fisher, or marten, or to possess green hide of any fur animal taken out of season. No other restrictions on skins legally taken.

Shipment and export: Unlawful to export skins of fur animals except under certificate of inspection and permit (fee, 50 cents) from a game inspector.

Propagation: Permits (fee, $1) to take wild animals may be obtained from minister of lands and forests under such restrictions as he may prescribe. Unlawful to keep fur-bearing animals, except silver foxes, in captivity for breeding purposes without a permit from minister of lands and forests; fee, $2 for each kind of animal kept, payable annually. Reports are required annually on December 31. Unlawful to trespass on inclosures for fur animals.

Bounties: None paid.

ONTARIO

Open seasons:[25]	*Dates inclusive*
Mink, fisher, marten	Nov. 1–Feb. 28.
Raccoon	Nov. 1–Dec. 31.
Muskrat (see exception)	Apr. 1–May 21.
Exception: South of French and Mattawa Rivers	Mar. 15–Apr. 21.
Beaver, otter, north Canadian National Railway	Dec. 15–Mar. 31.[26]
South	No open season.
Other fur animals	No close season.

Prohibited methods: Unlawful to shoot or spear muskrat, beaver, or otter, to injure or destroy any muskrat or beaver house or beaver dam, or to set trap closer than 5 feet to a muskrat house or 20 feet of a beaver house, or to destroy dens of fur animals, except wolves. Trapper may not possess poison.

Licenses: Trapping, $5 (issued to resident only); issued by department of game and fisheries. License not required of residents to take bear, wolf, or fox by means of gun or dog. Only resident Indians permitted to take beaver or otter. Farmers and their sons may trap on own land during open season without license. Fur dealers or traders: Resident, British subject, $25 (store license), $100 (traveling fur buyer), $100 (wholesale license); resident, $1 (restricted—buying for personal use); alien or nonresident, $200; nonresident, $5 (buying from wholesalers); licensee must make reports monthly. Fur dressing and tanning, $10; licensee must keep records and make monthly reports.

Possession and sale: Possession of furs during close season and the sale of unprime skins prohibited, except under permit. Unlawful to have skins dressed, plucked, or treated in any way except under permit obtained upon payment of royalties.

Shipment and export: Export prohibited except under permit obtained upon payment of royalties. No other restrictions on skins legally taken, possessed, or tagged; shipments must be made by express or parcel post and packages must be marked with a list of the contents and the names and addresses of consignor and consignee.

Propagation: A permit is required of breeders of game or fur animals (fee, $5, 50 acres or less). Licensed fur breeders may sell live animals or skins during open season upon payment of royalties. Minister may grant permits to take limited number of fur animals for propagating purposes during close season, upon payment of prescribed fees.

Bounties: Adult wolf, $15; wolf pups under 3 months old, $5; paid by county, but provincial treasurer refunds 40 per cent to the county. Provincial treasurer pays entire bounty in unorganized counties.

PRINCE EDWARD ISLAND

Open seasons:	*Dates inclusive*
Otter, marten, mink, muskrat, raccoon	Nov. 1–Mar. 31.
Beaver	No open season[27]
Fox	Dec. 1–Jan. 31.
Other fur animals	No close season.

Prohibited methods: Unlawful to put out poisoned baits for fox or other animals. Beaver dams protected.

Licenses: Trapping: None required of resident; nonresident, $50; issued by secretary-treasurer of Province. Game inspector may grant permits to take beaver and issue coupons (fee, $1 each) to tag skins of animals taken.[27]

Possession and sale: Possession and sale during close season prohibited. Holders of permits may possess, buy, or sell beaver skins that have proper coupons attached.

Shipment and export: No restriction on animals legally taken, possessed, and tagged.

Propagation: Several special acts of provincial legislature regulate fox ranching on the island. The animals are assessed for taxation, ranches are protected from trespass under heavy penalties, and incomes from ranches are taxed.

Bounties: None paid.

QUEBEC

Open seasons:	*Dates inclusive*
Bear	Aug. 20–June 30.
Beaver[28]	No open season.
Muskrat (see exception)	Nov. 1–May 31.
Exception: South of 50th parallel	Mar. 15–Apr. 30.
Fox	Nov. 1–Feb. 28.
Otter	Dec. 15–Mar. 31.
Other fur animals	Nov. 1–Mar. 31.

Prohibited methods: Use of poisons in taking fur animals prohibited. Beaver houses protected, and traps may not be set within 20 feet thereof.

Licenses: Resident, $5; nonresident, $200. Not required of resident for trapping on own land. Resident British fur dealer, $25; fur peddlers purchasing for themselves or as agents, resident British, $100; resident alien, $200. Resident wholesalers, British, $100. Nonresident traders buying from wholesalers, $5; dealers in dressed and prepared furs, $10. Fur tanners and dyers, $10. Dealers and buyers must make monthly reports.

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[24] *Nova Scotia:* Fox, raccoon, skunk, weasel, or muskrat may be killed on one's own inclosed premises for protection of private property.

[25] *Ontario:* Fur animals may be destroyed in defense of property, but skins so taken must be reported within 10 days, and may not be sold during close season except under permit from minister.

[26] Beavers and otters may only be taken by resident Indians and then only in the district in which they live. Under special permit from minister, overseer, or other officer may take or kill beavers doing damage to roads or private property.

[27] *Prince Edward Island:* Beavers may be taken under special license (see "Licenses"). They may be destroyed by the owner of private property on which they are locating and building dams, and, under permits from game warden or lieutenant governor in council, their dams may be destroyed when necessary to prevent damage to property.

[28] *Quebec:* Indians residing north of Canadian National Railway may take beavers, under permit from minister, in certain prescribed area, Dec. 15–Mar. 31. Minister may have beaver taken at any time for protection of property.

Possession and sale: Beaver skins must be tagged. No other restrictions on skins legally taken and on which royalty has been paid.

Shipment and export: Shipment and export prohibited, except of fur animals or furs on which royalties have been paid. Skins must be shipped open to view and each skin must be stamped to show royalty paid and be tagged as prescribed by minister before being shipped in any manner. Packages must show names and addresses of consignor and consignee.

Propagation: Minister may grant permits to take or keep animals alive for breeding purposes.

Bounties: Wolf, $15.

SASKATCHEWAN

Open seasons:[29]	*Dates inclusive*
Beaver	No open season.[30]
Fox	Nov. 1–Feb. 28.
Mink, fisher, marten, lynx	Nov. 1–Mar. 31.
Otter	Nov. 1–Apr. 30.
Muskrat:[30]	
North of Township 52	Mar. 1–May 14.
South of Township 53	Mar. 1–Apr. 30.
Other fur animals	No close season.

Prohibited methods: Unlawful to use poison to take fur animals, to snare wolves, coyotes, or foxes, to spear or shoot beavers or muskrats, or to destroy beaver dams or muskrat houses.

Licenses: Trapping: Resident, $2 (children or wards under 18 of licensee may trap on his land under his license); nonresident domiciled in Canada, $25; alien, $50; resident licensee must return license on or before May 31 to game commissioner with statement showing number of each kind of fur animals taken by him. Fur dealer: Resident, $10 (store); traveling dealer, $50; traveling agent for resident dealer: Permit $50, $10 for permit north of Township 56; nonresident, $50 (store); traveling agent for nonresident or nonresident traveling dealer, $100; wholesale dealer, $100. Taxidermist: $5; licensee must keep duplicate receipt book and furnish a copy thereof every 3 months to the minister. Tanner: $1; licensee must keep record and make monthly report. Issued by department of agriculture, Regina. Licensed fur trader must make monthly and annual reports of operations. Resident treaty Indians may trap during open season without a license. Consent of owner or occupant required to trap on inclosed or cultivated lands of another.

Possession and sale: Unlawful to buy, sell, or possess unprime pelts of protected fur animals.

Shipment and export: Packages containing fur animals must be plainly marked with full description of contents and names and addresses of consignor and consignee. Export of live fur animals prohibited except under permit of minister; fees for black or silver fox, $25; for cross or red fox or other live fur animal, $5. Unlawful to ship unprime furs or to export any raw furs on which royalty has not been paid. No other restrictions on skins legally taken.

Propagation: Permit required (fee, $5 annually) to operate a fur ranch. Permittee may ship live fur animals bred in captivity upon exhibiting fur farm permit to express agent.

Bounties: Adult timber wolf, $10; pups of prairie or timber wolf, $1; paid only in properly gazetted wolf districts, when half is refunded from provincial treasury.

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[29] *Saskatchewan:* Lieutenant governor in council may alter seasons. Trapping on game preserves prohibited.

[30] Minister may authorize council of any municipality to destroy beavers or muskrats doing damage to highways or other public improvements.

YUKON

Open seasons:[31]	*Dates inclusive*
Beaver	Sept. 30, 1931.
Muskrat, otter (see exceptions)	Jan. 1–June 30.
Exception:	
Muskrat, south of Arctic Circle	Dec. 1–May 31.
Otter, south of Arctic Circle	Jan. 1–May 15.
Lynx, marten, mink	Nov. 15–Apr. 1.
Fox (see exception)	Nov. 15–Mar. 31.
Exception: South of Arctic Circle	Nov. 1–Jan. 31.
Other fur animals	No close season.

Prohibited methods: Use of poison, pitfalls, spears, or similar devices prohibited, except that commanding officer, Royal Canadian Mounted Police, Dawson, may grant permits to poison wolves and other predatory animals. Traps must be taken up within 15 days after close of open season. Unlawful to dig up or destroy beaver dam, runway, or house.

Licenses: Trapping: None required of resident; nonresident, $100. Fur buyer or dealer (purchasing furs for sale or export): Nonresident, $150; resident, $25; mercantile establishment buying furs, $25 (required for each place of business other than head office); issued by gold commissioner or person designated by him.

Possession and sale: Skins legally taken may be possessed and sold at any time.

Shipment and export: Export of raw furs prohibited except under permit issued by direction of the commissioner and upon payment of the export tax. Export of live foxes prohibited. (See "Propagation.")

Propagation: Registration of fox breeders required. Unlawful to export a fox not born in captivity or which has been in captivity for less than a year; any fox born in captivity may be exported under a permit (fee, $5). Fox and other fur ranches, if posted against trespass, may not be approached without owner's consent. Live foxes may be captured for breeding purposes, May 1–Nov. 1, but use of steel trap or wire snare prohibited. No restrictions on other fur animals.

Bounties: Wolf, $30; coyote, $15.

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[31] *Yukon:* Commissioner in council may alter seasons.

LAWS OF NEWFOUNDLAND

Open seasons:[32]	*Dates inclusive*
Otter, marten, lynx	Oct. 1–Mar. 31.
Fox	Oct. 15–Mar. 15.
Muskrat	Oct. 1–Apr. 30.
Beaver	No open season.[33]

Prohibited methods: Beaver house or dam must not be damaged by trapper. Use of poisons and wire snares prohibited.

Licenses: Trapping: None required of residents; nonresident, $501; issued by game and inland fisheries board or authorized agents. Fur buyer and shipper, 50 cents; issued by game and inland fisheries board. Fur buyer must report operations semiannually on or before June 30 and December 31 of each year.

Possession and sale: No restrictions on skins legally taken, except beaver.

Shipment and export: Unlawful to export a live fox unless raised in captivity. No restrictions on skins legally taken.

Propagation: No restrictions, except as to fox. A fox farm must be licensed; the owner must at stated times make reports to game and inland fisheries board, and premises must be at all times open to inspection by officers of the board. Possession of fox cub or fox taken in close season is prohibited. Unlawful to export a fox not bred on a fox farm, or without permit from board to export a fox bred in captivity.

Bounties: Crow, 50 cents.

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[32] *Newfoundland:* Unlawful to trap on Grand Lake Caribou Preserves.

[33] Governor in council may proclaim open season on beavers in certain localities, when not more than 25 may be taken by resident trapper of 3 years' standing, under beaver-trapping license. Skins of beavers must be forwarded through magistrate to game and inland fisheries board, which has sole power to purchase or export.

LAWS OF MEXICO[34]

Open seasons:	Dates inclusive
Bear	Sept. 1–Oct. 31.
Fur-bearing animals	Nov. 1–Feb. 28.
Kinkajou	Oct. 1–Jan. 31.
Armadillo	Nov. 1–Jan. 31.
Alligator	Sept. 16–May 31.

UNITED STATES GAME PROTECTORS OF THE BUREAU OF BIOLOGICAL SURVEY

[Violations of the Federal Lacey Act, prohibiting shipment by common carrier of the dead bodies of wild animals, or parts thereof, including the skins of fur-bearing animals, that have been killed or shipped contrary to State law, may be reported to the nearest official listed below, or to the Chief, Bureau of Biological Survey, United States Department of Agriculture, Washington, D. C.]

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4947 Schollmeyer Avenue, St. Louis, Mo.
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Box 1168, Houston, Tex.
P. S. Farnham,
Owego, N. Y.
William H. Hoffman,
Box 1022, Mobile, Ala.
John Q. Holmes,
Care Hotel Hill, Omaha, Nebr.
Floyd A. Johnson,
General Delivery, New Orleans, La.
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This bulletin is a contribution from

Bureau of Biological Survey	Paul G. Redington, *Chief.*
Division of Game and Bird Conservation	H. P. Sheldon, *in Charge.*
Division of Fur Resources	Fnank G. Ashbrook, *in Charge.*

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[34] *Mexico:* For further information concerning trapping and fur laws, communicate with Secretaria de Agricultura y Fomento, City of Mexico.

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SORGO FOR SIRUP PRODUCTION: CULTURE, HARVESTING, AND HANDLING

By H. B. Cowgill, *Associate Agronomist, Office of Sugar Plants, Bureau of Plant Industry*[1]

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INTRODUCTION

SORGO is the name now used for the varieties of sorghum that have abundant sweet juice, the name being applied to distinguish these varieties from grain-producing and other varieties. These saccharine or sweet varieties are sometimes called sweet sorghums and saccharine sorghums. The sorghum species includes kafirs, milos, and kaoliangs, cultivated for their grain; broomcorn, cultivated for the brush from which brooms are made; grasslike forms, such as Johnson grass and Sudan grass, cultivated for forage; and sorgo, cultivated both for making sirup and for forage. The grain sorghums are mainly grown in a geographical region different from that in which sorgo is grown for sirup production, this also in a large measure being true with regard to sorgo when grown for forage purposes. Climatic conditions as well as soil types are in general different in these two regions, and cultural methods and methods of handling the crop differ, because of the difference in utilization. At earlier periods the plant was given extensive investigation as a possible source of commercial sugar.[2] Some of this

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[1] Acknowledgments are made to S. F. Sherwood, senior biochemist, for analyses of sorgo juices, and to the Bureau of Entomology, U. S. Department of Agriculture, for the section on insects injurious to sorgo.

[2] BOLLMAN, L. CULTIVATION OF THE SORGHUM. U. S. Dept. Agr., Commr. Agr. Rpt. 1862: 140–147. 1863.

CLOUGH, W. SORGHUM, OR NORTHERN SUGAR-CANE. U. S. Dept. Agr., Commr. Agr. Rpt. 1864: 54–87, illus. 1865.

WILEY, H. W. THE SUGAR INDUSTRY OF THE UNITED STATES. INTRODUCTION. PART I.—CANE SUGAR. PART II.—BEET SUGAR. PART III.—SORGHUM. PART IV.—MAPLE SUGAR. U. S. Dept. Agr., Chem. Div. Bul. 5, 324 p., illus. 1885.

information is applicable to present-day conditions in the growing of the crop for sirup-making purposes; but much of it is not applicable, and much of it is now out of date. This bulletin has been prepared to give recommended practices in the culture and management of the crop, including planting, cultivating, harvesting, and handling, applicable to conditions prevailing at the present time.

The production of sorgo sirup has varied considerably from year to year. According to census estimates it amounted to 16,532,000 gallons in 1909. In 1920 the production had increased to 49,505,000 gallons, according to estimates of the United States Department of Agriculture, and the average price received by producers in that year was $1.069 a gallon, making the value of the crop in that year approximately $52,922,000. This large increase in production and the price received per gallon were due partly to a scarcity of sugar following the World War. Subsequent to 1920 there was a decrease both in production and in price received by producers, 24,926,000 gallons, having an average value of 94.9 cents, being produced in 1925, according to Department of Agriculture estimates, and 26,972,000 gallons, having an average value of 91.5 cents, in 1928.

Sorgo sirup is much more commonly used in the States where it is produced than in other sections. The homemade product is often of very high quality, being light in color, mild, and of fine flavor. It is well liked as a table sirup, especially by those who are accustomed to it. Without doubt it is a wholesome food product.

PROCESS OF MANUFACTURE OF SORGO SIRUP[3]

The methods employed in the manufacture of sorgo sirup are briefly presented here in order better to show the requirements and the relation that cultural, harvesting, and handling practices bear to quality.

The making of sirup from sorgo, whether done with the usual farm equipment or in a commercial factory, consists essentially in pressing the juice from the stalks—usually by passing them through mills consisting of steel rolls; removing impurities from the juice; and concentrating the juice by evaporation. The leaves and seed heads are usually removed from the stalks before the milling process takes place; when the crop is made up with the usual farm outfit they are generally removed before the stalks are hauled from the field, but in commercial factories the leaves and sometimes the heads are not removed until the stalks have reached the factory. Impurities in the juice are largely eliminated either just previous to or during the process of boiling it down. Heating causes some of the albuminous substances contained to coagulate and rise to the surface, carrying with them other particles of solid matter present, including particles of the leaf sheaths and stalks. Where sirup is made on a small scale, these are removed by skimming, but in commercial factories pressure filters are often used. Filtration may be assisted and jellying of the sirup avoided by treating the juice with extract of malt. Water is sometimes applied during the milling process in the factories to help remove sugar-bearing juice; lime is sometimes introduced to counteract some of the acidity and to assist clarification; and either from the start or only during the final concentrating or finishing process the juice is sometimes boiled under a partial vacuum at a comparatively low temperature in order to hasten evaporation and to avoid scorching the sirup.

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[3] The making of sorgo sirup is treated more fully in the following publication: BRYAN, A. H., and SHERWOOD, S. F. SORGO-SIRUP MANUFACTURE. U. S. Dept. Agr. Farmers' Bul. 1389, 29 p., illus. 1924.

EXTENT OF CULTIVATION OF SORGO FOR SIRUP MAKING

The adaptability of the sorgo crop to many soils and climatic conditions is noteworthy. It is cultivated over a wide area, being now grown to some extent for sirup making in 35 or 40 States, including States with as diverse climatic conditions as Minnesota, Alabama, Indiana, and New Mexico. Commercial sorgo-sirup factories are operated in States with as diverse climatic conditions as Minnesota and Arkansas. The crop is grown most extensively as a source of sirup in the Southern States. A so-called sorgo belt extends from Virginia, West Virginia, North Carolina, South Carolina, and northern Georgia through Kentucky, Tennessee, Missouri, Arkansas, and Oklahoma, including also the northern parts of Alabama, Mississippi, and Louisiana. (Fig. 1.) For the most part, the production of sirup is on a small scale. The average area grown for sirup-making purposes on individual farms is somewhat less than an acre. It is therefore a secondary crop on most farms, the sirup being made in the neighborhood for home use, or with a small surplus for sale. When sorgo is grown for the use of commercial factories the growers generally produce the crop on contract. The product of the factories is sold through the usual trade channels.

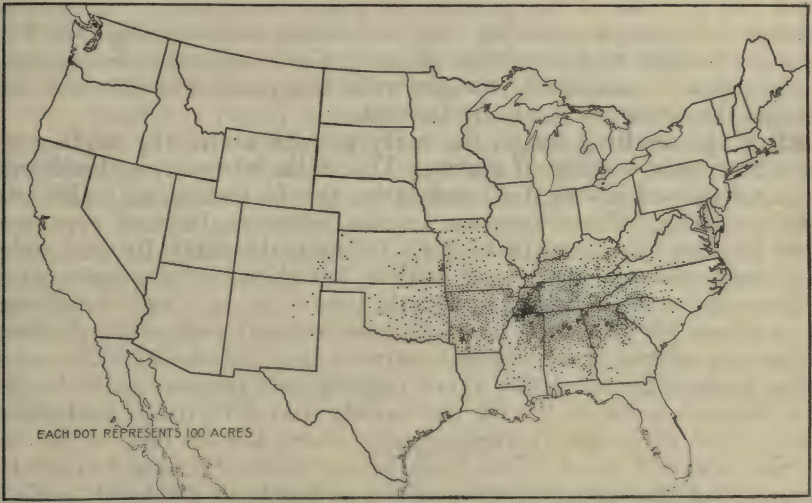

FIGURE 1.—Outline map showing the distribution of the cultivation of sorgo for sirup-making purposes in the chief sirup-making States in 1924, taken from the United States Census of Agriculture of 1925. The largest acreage was in Tennessee, 27,802 acres, followed by that of Arkansas, 26,218 acres. Acreages not shown on the map include those of Texas, 7,610 acres; Iowa, 1,288; Colorado, 1,084; Florida, 723; and Minnesota, 681

DESCRIPTION OF THE SORGO PLANT

Sorgo is a member of the grass family. It is less closely related to sugarcane than it is to kafir, milo, feterita, broomcorn, Johnson grass, and Sudan grass.[4] These latter belong to the same species of plants as sorgo. Sorgo is perennial in the Tropics but winterkills in regions where frosts are severe.

Young sorgo plants are delicate, and growth is slow. In germinating, the radicle (the first root) bursts through the seed coat only slightly before the plumule, which later develops into the sprout that grows upward. In its upward growth the plumule forms the first node or joint always just beneath the soil surface, where it puts forth permanent roots. When the seed is planted deep the plumule may grow 2 inches or more in length before forming a node. At this point the growth of the permanent plant commences, the seedling portion withering and dying after a number of nodes together with their permanent roots have developed. The temporary development of the plant is sometimes thought to be a taproot, but this is a mistake, as the sorgo plant has no taproot.

After the seedling stage, the early growth above the surface appears to consist mainly of leaves. The stalk, however, is developing during this period—at first mainly by the formation of nodes very close together. These increase in size successively, and very soon there is some development of stalk between the early formed nodes. The internodes are very short at first, but they increase successively in girth and to some extent in length, thus forming a somewhat cone-shaped base for the stalk. A leaf is produced at each node, the bases or sheaths of the leaves closely surrounding the stalk. The internodes from this time grow more rapidly and become much longer. The number varies both with the variety and with individual stalks, but in most cases the average number above the surface of the soil is from about 8 to 12. The stalk tapers from the base toward the summit, but the last internode, or the peduncle of the head, is about uniform in thickness. The exterior of the internodes is hard and tough, being composed to a large extent of fibrous material called fibrovascular bundles. Over the surface there is a thin film of waxy bloom which is white in early stages, but becomes dark in maturing. The interior of the stalk is mainly composed of soft pith which contains sweet juice. The peduncle, however, is somewhat more fibrous than the other internodes.

Permanent feeding roots for the most part originate from the lower nodes or joints of the stalk that are beneath or slightly above the surface of the soil. They are always most abundant in the surface soil and radiate in all directions. The plant obtains its mineral nutrients largely from the upper foot of soil, although some of the roots often extend as much as 3 or 4 feet downward. When the soil is moist, roots may be put forth also from nodes that are considerably above the surface, as well as from nodes still farther upward on stalks that have lodged. These are strong and tough, and those from the lower nodes help to anchor the plant to the soil.

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[4] Sorgo is most easily distinguished from sugarcane by the fact that it always produces a small or medium-sized seed head at the summit of the stalk, the seed produced in this head being about one-eighth inch long. Sugarcane, on the other hand, does not produce seed in the United States, except in southern Florida, and the inflorescence which bears the seed is several times as large as the inflorescence (head) of sorgo, while the seed is much smaller than the sorgo seed. The stalk of sugarcane has a harder rind, and the plant usually tillers more abundantly than sorgo. Many varieties of sugarcane shed their leaves as the plants approach maturity, which is not the case with sorgo. The term cane should not be used when sorgo is referred to, and the terms Ribbon cane, Japanese Ribbon, and Texas Seeded Ribbon are also objectionable when used in reference to varieties of sorgo, as Ribbon and Japanese are names applied to varieties of sugarcane.

When the plants have attained a height of 3 to 6 inches some of the buds at lower nodes develop into shoots which later become secondary stalks or tillers. In early stages these tillers can be distinguished from initial stalks, as they grow out obliquely. Later their direction of growth becomes upright and they develop independent root systems, and it is difficult to distinguish them from the initial stalks. They are equal to initial stalks for sirup making, except that they mature later. The lack of uniformity in the maturity of the stalks and tillers may sometimes affect the quality of the sirup.

Both initial stalks and tillers put out short branches from their upper nodes, branches being most abundantly produced when the plants are approaching maturity and when rains occur after a period of dry weather. Under normal conditions each branch is terminated by a head. When stalks become lodged after reaching maturity, branches growing from them sometimes become rooted to the soil and have an independent growth, but this can occur only when the variety reaches maturity sometime before killing frosts. The branches, as well as tillers, are frequently called "suckers"; but this term is a misnomer and does not distinguish between them. Branches are of no value for sirup making. Juice expressed from them contains more impurities than the juice from the stalks and is often dark in color; no doubt this is due to the fact that a large part of the branch is the peduncle of the head which surmounts the branch.

CULTURE

The primary purpose in producing the crop is to obtain the largest possible yield of sirup of good quality, rather than a large tonnage of stalks or a high yield of grain, as in the case of sorghums grown for forage and grain, and the method of culture is therefore somewhat different. The requirements in general are more exacting, and methods of handling are more expensive than when sorgo is utilized for forage. The yield of sirup depends primarily on the tonnage of stalks, the amount of expressible juice, and the proportion of sugar in the juice. There are also secondary factors which affect the yield, the economy of handling the crop, and the quality of the product. These include uniformity in the growth of the stalks and uniformity in reaching maturity, the erectness and size of the stalks, the ability to withstand deterioration after reaching approximate maturity, and the relative freedom from undesirable substances that would enter the juice and as impurities to a greater or lesser extent lower the quality of the sirup.

The yield is more under the control of the grower than are the other factors, because by a wise choice of varieties, efficient cultural practices, and the use of fertilizers he can often obtain increased tonnage of stalks. In general, the largest yields are obtained from varieties that require the longest periods for their development, and maximum weight of the stalks occurs when the growth of the plants has attained its maximum and the cells of the pith contain the largest proportion of sugars.

SELECTION OF THE FIELD

Sorgo can be grown on many kinds of soil, being much less exacting in this respect than many other crops; but in order to obtain the best yields a soil of good physical character and high fertility should be chosen. On the poorer soils it is more difficult to get a satisfactory stand; growth is slower, and the stalks do not reach as large size. The field should have good natural drainage, especially in localities where there are liable to be periods of excessive rainfall; and if the planting is to be done early in the season, a soil that becomes warm early should be selected. A loam or a sandy loam is better than a clay or a silt soil, the former being warmer, better drained, usually more fertile, and having less tendency to form crusts through which the sorgo seedlings are unable to push to the surface.

A belief prevails in some localities that certain kinds of soil have a pronounced effect upon sirup quality. Crops grown on light-colored sandy soils, as well as on light-colored upland soils of a heavier texture, are thought by many to give sirups of finer flavor and better color than those on heavy, dark soils. It is probably true that in general it is more difficult to obtain sirup of high quality from crops produced on soil rich in organic matter, because the leaf sheaths around stalks grown under such conditions contain more green chlorophyll, and the tissues are softer, with the result that more undesirable matter is crushed out. Sirup of good quality, however, is frequently made from crops grown on soils especially rich in organic matter; and the effect of the soil on quality is apparently much overestimated. Since practically all cultivated soil contains organic matter, it is difficult to say when the quantity is excessive.

PLACE OF SORGO IN ROTATION WITH OTHER CROPS

Consideration should be given to the crop that was grown on the land in the preceding year and to what crop will follow sorgo. Cropping systems in which sorgo is grown are varied. This is due largely to the fact that sorgo is cultivated over a wide area. In much of the southeastern division of States, where sorgo is most extensively grown for sirup making, as well as in Arkansas and parts of Louisiana, Oklahoma, and Texas, cotton is the chief crop. When sorgo is grown in these sections it is generally made to fit into any system of cropping followed in the production of cotton. Some such system as the following is often practiced: (1) Cotton the first year; (2) sorgo the year following the cotton crop, with or without cowpeas between the rows planted at the last cultivation; and (3) winter wheat or oats in the third year, followed by cowpeas as a catch crop. Cotton is generally given clean cultivation. It is for this reason a good crop to precede sorgo, there being fewer weed seeds in the soil to grow and interfere with the development of the sorgo seedlings; and even on upland soils that are not best suited to growing corn, sorgo may usually be successfully grown following cotton.

In the Northern States sorgo may be substituted for corn in the system of cropping followed.

The cultivation of sorgo is similar to that of corn. Because the more leafy growth of sorgo causes more shade, and because of the difficulty of harvesting the sorgo without to some extent injuring the catch crop, it is less suitable as a crop to be followed by such leguminous crops as cowpeas and soybeans between the rows.

In many cases it is feasible in the Southern States to grow a winter cover crop on the land following sorgo. Such crops tend to prevent the leaching out of soil nutrients and add humus and nitrogen to the soil when they are turned under. When such a crop can be grown and the land subsequently gotten ready early enough for the succeeding crop, it is often a good practice. Bur clover, crimson clover, hairy vetch, rye, and barley are some of the crops that have been recommended for this purpose.

Sorgo is generally considered somewhat hard on the soil, the opinion being common that sorgo, as well as grain sorghums, leave the soil in poor physical condition and that the yield of the crop following sorgo or other sorghums may be somewhat reduced. The effect is not permanent. It is advisable to keep in mind this more or less injurious effect when selecting a field, even though the effect is temporary. The crop that follows should not be one that is easily affected by adverse conditions. Among crops that have been successfully grown are the following: Oats, planted in March or April following sorgo harvested as late as October or November; cowpeas following oats planted as above, or planted in May on land that was in sorgo the previous year; velvetbeans and soybeans planted in May or June on land that was in sorgo the previous year.

CLEARING AND PREPARING THE LAND

Thorough preparation of the soil is always advisable. The field should first be cleared of all growth of a character that will not quickly decay when plowed under. It should then be broken with the plow as deeply as possible without turning up considerable quantities of subsoil and worked down into a good seed bed. Precautions should be taken to have the seed bed free from weeds, as free as possible from weed seed, and firm enough to promote capillary movement of moisture. The above ends are facilitated by the use of the harrow, and the disk harrow is especially recommended, because it is very effective in destroying young weeds and packs the soil beneath the surface. Considered only from the viewpoint of maximum growth, the land should be plowed in the fall or winter, or early in the spring, in order to allow the remains of a preceding crop or other growth to become at least partly decayed before planting time and to facilitate the acquisition of moisture for the crop, but when man and team labor are abundant it may be better to plow, harrow, and plant at the proper time for planting, as it is often possible in this way to prepare the land when conditions are most favorable and to utilize the moisture present in the soil for the germination of the seed. There is then also not as great a loss of soil nutrients by erosion.

Provision should be made for carrying off excess surface water from the field, especially when natural drainage is poor and where spring rainfall is normally heavy. Standing water is often injurious. It may cause the soil to crust or bake, in this way preventing young shoots from reaching the surface, and it sometimes kills or weakens the plants after they are up, especially in early spring when the soil is not thoroughly warm and when night temperatures are low. After the plants are thoroughly established in the soil, little injury results from standing water. Ditches may be provided through or around the fields. They should be made in such a manner that excess rainfall will be carried off with the least washing or eroding. It is the usual practice in some localities to ridge or bed the field, either with a lister or by turning two furrow slices together with a single moldboard plow. The planting is then on the ridge. (See fig. 10, p. 31.) If properly done a firmer seed bed is thus obtained, and trash, clods, and often much weed seed are thrown out of the rows into the furrows. It is generally not necessary or advisable to make the ridges high, and it is good practice partly to level them down by dragging off the tops with a plank drag. In some cases growers open a shallow water furrow on top of the ridge for the planting. The soil remains moist for a longer time in these water furrows, as water from light rains collects in them. The deeper furrows on each side of the ridge carry off the excess water.

In localities where rainfall in the spring is often excessive, planting on ridges tends to a more uniform stand, and growth is enhanced at a time when the plants are passing through their most delicate period, the soil in the ridges being drier, warmer, and in better physical condition.

Ridging as usually done has some disadvantages: (1) The expense is greater for both preparation and cultivation, and (2) the rows have a greater tendency to dry out in dry weather. By making the lister furrows shallow and the water furrows somewhat deeper than is customary, the first disadvantage is largely overcome, as the cultivation then becomes level or nearly level after the first or second time over the field, and the cost of cultivation is then about the same as when the planting is on the level field. The method is not as suitable for the drier sections, or for semihumid sections where the planting is done after the soil has become thoroughly warm. Evaporation is then generally sufficient to take care of the excess moisture.

USE OF FERTILIZERS

Whether the use of fertilizer is advisable depends primarily on the fertility of the field. Sorgo responds well to applications of either barnyard manure or commercial fertilizer. Fertilizer helps to get a stand and to get the plants through the first two or three weeks of growth, beneficial results often being noticeable soon after the seedlings emerge through the soil. Later growth is also often more vigorous on naturally fertile soil or soil that has been treated with a fertilizer. (Fig. 2.) The use of fertilizer sometimes makes a difference of 10 days or 2 weeks in the maturity of the plants, the yield of sirup being considerably increased and the mature stalks being larger.

The formula that should be used will depend much upon local conditions. The experience of the grower or his neighbors with fertilizers for grain sorghum or for other crops may be used as a partial guide until fertilizer tests have been made. In experiments[5] with fertilizer for sorgo on clay, clay loam, and silt soils, 300 pounds per acre of a mixture containing 6.18 per cent nitrogen (equivalent to 7.5 per cent ammonia) and 7.5 per cent phosphoric acid was an economical application. No benefit followed from the use of potash in these experiments.

Much of the needed nitrogen may be supplied by growing leguminous crops, either as catch crops or in rotation with the sorgo crop. When this is done, unless fertilizer tests indicate that potash is needed, purchased fertilizer should contain a relatively large proportion of phosphoric acid. This may be supplied either in the form of acid phosphate or as bone meal. The additional nitrogen needed may be supplied in the form of cottonseed meal, sulphate of ammonia, or nitrate of soda, or all three may be used.

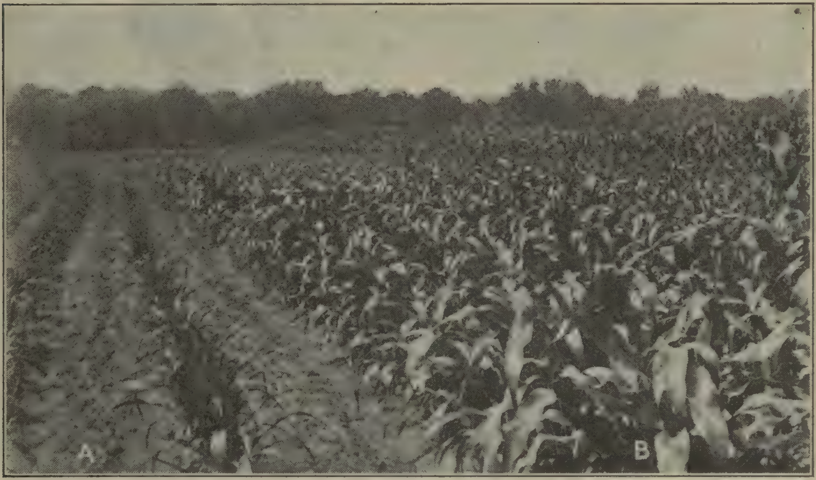

FIGURE 2.—Beneficial effect of an application of fertilizer on the growth of sorgo. The rows on the left (A) received no fertilizer; those on the right (B) received an application of fertilizer containing 6.8 per cent of nitrogen, equivalent to 7.5 per cent of ammonia, and 7.5 per cent of phosphoric acid, applied at the rate of 500 pounds per acre

Commercial fertilizers and cottonseed meal should be applied in the row either a short time before or at the time of planting. Sometimes only a part is applied at that time, the remainder being used as a side dressing at one of the cultivations. In many sections a part or all of the summer season is often droughty, so that there is not moisture enough in the soil to make available such fertilizer as is applied late in the season. The probability of beneficial results is therefore not as great from fertilizer applied as a side dressing as from that applied in the row before or at the time of planting. It is advisable to apply the fertilizer when the soil is somewhat moist. The seed should never be allowed to come in direct contact with it, especially if it is composed of chemical ingredients. This may cause the seedlings to "burn." On this account, as well as to reduce to a minimum losses from leaching, the fertilizer should be covered or incorporated with the soil. Sometimes it is applied in rows on the surface and two furrow slices are turned together over it, the seed being planted on the ridges. In other cases the fertilizer is applied in shallow furrows and covered or incorporated. There are several types of planter having fertilizer attachments that successfully deposit fertilizer and cover it either before or after dropping the seed. (Fig. 3.) In the latter case the seed is covered with a thin layer of soil before the fertilizer is deposited.

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[5] Fertilizer experiments conducted cooperatively by the Office of Soil Fertility, Bureau of Chemistry and Soils, the Office of Sugar Plants, Bureau of Plant Industry, and the Best-Clymer Manufacturing Co., in the vicinity of Fort Smith, Ark., 1919 to 1921.

CHOICE OF SEED FOR PLANTING

When obtaining seed both the variety and the quality should be given consideration, because the large numbers of varieties now grown vary greatly with regard to the length of their growing period and their sugar content at time of harvest, as well as with regard to other characteristics that may affect the quantity and the quality of the sirup produced. The normal growing period for different varieties varies from 75 to 150 days. Although all of these may be grown in the Gulf States and many of them in the Central States, the limiting factors of late spring frosts, necessitating late planting, and early killing frosts in the fall result in only a limited number of early-maturing varieties being suitable for culture in the Northern States.

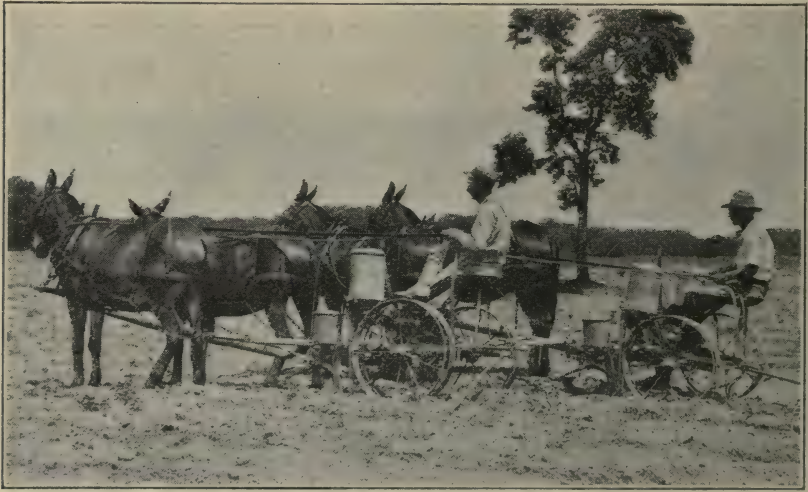

FIGURE 3.—Two 2-row planters with fertilizer attachments suitable for planting sorgo

There is at present much confusion in regard to the varietal names, and until standard varieties are better recognized it may be difficult to obtain seed of superior varieties. It is a better practice to plant a variety that is known to have given good results in the community than to obtain seed from outside sources. When it is necessary to obtain a new variety, field tests and analyses made by the United States Department of Agriculture, State experiment stations, and others should be consulted.[6]

Although varying climatic conditions from year to year affect the length of the growing period to a considerable extent, the early varieties under normal conditions reach the hard-dough stage—which is the most suitable state of maturity for harvesting for sirup production for a large number of the varieties—in 75 to 100 days from date of planting. Early-maturing kinds called Amber varieties are the most suitable for the more northerly States, where the growing season is shortest. There are a number of these, and they vary considerably in sugar content, yield of stalks per acre, and other characteristics. Minnesota Amber, which normally requires 85 to 95 days to reach the proper stage of development for sirup making, is one of the best of this group, although Indiana Amber, which develops in about the same length of time, is favored in some localities.

A number of medium-late varieties maturing in 100 to 125 days are grown in certain districts. Among them the following are recommended for sirup making: Folger, Red X, McLean, Sapling, Sugar Drip, White African, and Sumac. Folger is the earliest of this group, normally reaching the hard-dough stage in 100 to 110 days. It has a high sugar content and is considered by many growers a superior sirup variety. The other varieties just named normally require 110 to 125 days, the last three usually needing a somewhat longer time than the first three. Red X has proved to be one of the best of all varieties now being cultivated with regard to sugar content. The varieties in this group are suitable for localities in the Central States where the season is intermediate in length.

Honey and Gooseneck are two late-maturing varieties that are recommended. There are a number of strains of the Honey variety that differ with regard to the number of days required to mature, the most commonly grown strain requiring normally about 125 to 135 days. This variety is commonly cultivated in the southern part of the sorgo-sirup belt. Though its sugar content is not as high as that of some others, in general this is more than compensated for by a higher yield of stalks per acre. The sirup obtained is also considered by many to be of superior quality.

Gooseneck usually affords a heavy yield of stalks per acre and a juice high in sugar content. It requires 125 to 150 days to reach the proper stage for harvesting, depending on climatic conditions. In general it is somewhat less popular with growers than Honey, probably due largely to the fact that the gooseneck type of heads interfere more or less with the handling of the crop after it is cut.

The quality of the seed is second in importance only to the variety chosen. Pure, well-cleaned, plump, well-developed seed, which has shown a high germination percentage by test, should be used. Seed produced in the year preceding is more certain of giving satisfactory results than older seed, although seed 3 or more years old will sometimes germinate and produce a good crop. Frequently commercial seed is impure. This condition materially lowers its value. When the seed contains a large proportion of chaff the resulting stand is liable to be more or less uneven, due to irregular distribution by the planter.

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[6] Provisional descriptions of 16 varieties of sorgo are given in the following publication: COWGILL, H. B. VARIETAL STANDARDIZATION OF SORGO AND THE SELECTION OF SEED. U. S. Dept. Agr. Circ. 52, 23 p., illus. 1929.

It is advisable to test the seed for germination, especially if it is not bright or shows any other signs of being of low vitality. The tests may be made by placing counted samples at regular intervals between sheets of blotting paper in shallow pans, keeping the blotting paper moist until the seed has sprouted, or patent germinators may be used. After sufficient time has elapsed for germination—say six to eight days—a count should be made of the number of seeds that have germinated and the percentage of germination thus determined. If the seed has been kept in the head until just previous to planting, the viability of individual heads may be determined by taking samples at random from each head and testing them in the above manner. The best heads only should be retained for planting. If it is not possible to obtain seed showing good germination, a relatively larger quantity per acre should be planted.

In some cases it may be advisable to treat the seed for the prevention of smut. (See pp. 36 and 37.) This would be especially desirable if the grower expected to sell pure, high-grade seed to the trade.

TIME OF PLANTING

It is advisable to time the planting so that the crop will reach the proper stage for harvesting when other farm work will not interfere. In the cotton-growing States it is desirable to have cotton picking completed before it becomes necessary to harvest the sorgo. The most suitable time will vary in different localities, different fields, and different years. In the Northern States it is advisable to plant as early as possible so that the crop may mature before killing frosts. This is also true in the Central States with regard to varieties that require a long growing season.

From the viewpoint of soil temperature it is desirable to delay the planting until the soil is thoroughly warm. This results in better germination and early growth and insures a more uniform stand. A vigorous early growth necessitates less cultivation and hoeing, and the crop may be laid by at an earlier date. However, an adequate supply of moisture is essential for satisfactory germination and early growth. For this reason it is not advisable to delay planting until rainfall is scant and the warming of the soil has resulted in an excessive loss of moisture. The soil may be so dry as to make it necessary to wait for rain or to replant the field later in the season. In either case the planting may be so late that the crop will not have time to mature properly.

When a comparatively large acreage is grown it may be well to make an initial planting as early as possible, following this by one or more later plantings, the purpose being to avoid having the entire crop reach maturity at one time. Harvesting and sirup making may thus extend throughout a longer period. This, however, often can best be accomplished by growing a number of varieties requiring different periods for maturing.

The planting period ordinarily extends from about May 10 to 31 in the Northern States, from April 20 to June 15 in the Central States, and from April 1 to June 15 in the Southern States.

METHOD OF PLANTING

The planting may be on the level field, on ridges or beds previously prepared, or in furrows. Planting in furrows is suitable for localities where spring rainfall is frequently deficient, or at least not excessive. More moisture is available for germination and early growth. Cultivation is also facilitated as it is easier to cover weeds and there is little danger of injuring the young plants. But in localities where heavy rains frequently occur, especially if the soil is heavy, it is better to plant either on the level field or on prepared ridges or beds. If planted in furrows, the seed or seedlings may be covered so deeply by the washing of soil upon them that sprouts and new leaves can not push through to the surface.

In selecting a planter the grower should see that provision is made so that the right number of seeds may be dropped at a place. In case the number of seeds dropped is regulated by the size of holes in the planter plate, it is sometimes necessary to obtain blank plates and have these bored with holes of the proper size and at the proper distance apart. Some manufacturers supply plates properly bored for sorgo. It is important also to see that provision is made for firmly pressing the soil in the row after the seed has been deposited, so that capillary movement of moisture from below may be facilitated. This is often done by means of concave wheels, or double wheels, which pass over the rows immediately after the seeds have been dropped. In general the 2-row type of planter is better adapted for depositing the seed at a uniform depth and for pressing the soil over the row, and better germination appears to result when this type is used. (Fig. 3.)

DEPTH OF PLANTING

The proper depth for planting depends upon the kind of soil and the amount of soil moisture. If possible the seed should always be planted in moist soil, but it should never be covered more than an inch deep, a half inch being sufficient if the soil is quite moist. Shallow planting is preferable on heavy soils which retain moisture, but deeper planting is necessary on light soils which have a tendency to dry out rapidly.

DISTANCE OF PLANTING

Rows should be spaced at a suitable distance to permit easy cultivation and harvesting, a space of 3½ feet being satisfactory unless intercropping with such crops as cowpeas and soybeans is practiced. In the latter case the rows should be at least 5 feet apart. The planting may either be in continuous drills, with the expectation of thinning to the desired stand, or the seed may be dropped in hills or at regular intervals in the row at the rate of three to eight seeds to the hill. The continuous drill method usually insures a more perfect stand, but the greater quantity of seed required and the necessity for thinning renders it more expensive. Moreover, unsuitable weather sometimes renders it impossible to thin at the proper time, and this results in the growth being retarded and the yield of stalks reduced on account of the stand being too thick. If the soil is moist and in good condition and the seed of high vitality, to drop a number of seeds at regular distances in the row is preferable.

The proper distribution of the seed depends upon the available fertility of the soil, the variety, and the method of planting. More seeds may be planted where plant food and moisture are abundant. On the average, a satisfactory stand may be obtained if three or four seeds germinate in each hill and the hills stand 10 to 14 inches apart in the row, but on poorer soils the hills should stand somewhat farther apart, and on the other hand if the seed is planted in checkrows a correspondingly larger number of seeds should be dropped in each hill.

The results of an experiment relative to the effect of spacing upon the number of tillers produced by sorgo plants are given in Table 1. Five varieties were used, and the plants were thinned to distances in the rows indicated in the table. The distance between rows was 40 inches. The count of the number of tillers was made at 51 to 55 days after planting. The results indicate that fewer tillers are produced when the plants are close in the row than when they are farther apart. It is also indicated that there is a tendency toward greater uniformity in the stand when the seeds are planted in hills than when planted at approximately equal distances in the row, because in case of uneven germination the stand tends to become uniform through the production of tillers.

It will be noted that with three varieties one row each was not thinned. In these rows the plants stood an inch apart, or less, in the row. None of the plants in these rows produced more than 2 tillers, whereas the average number was one-fifth tiller per plant, or an average of 1 tiller to each 5 plants. On the other hand, rows spaced to a single plant every 2, 3, 6, 9, and 12 inches produced tillers in larger numbers, the 12-inch spacing resulting in an average of approximately 3¼ tillers per plant, 1 plant producing 12 tillers, 3 producing 9 each, and 4 producing 8 each. In rows spaced so that three plants were left together at distances of 3, 6, 9, and 12 inches in the row, tillers were produced less abundantly than where single plants were spaced at these distances.

A preliminary count was made at 37 to 41 days after the planting. The number of tillers where the spacing was wide was in general greater at the time of the count recorded in Table 1 than at the time of the preliminary count.

TABLE 1.—*Effect of spacing sorgo plants in the row on the production of tillers*

Distance between plants in the row	Number of plants counted	Number of varieties included	Tillers per plant		Distance between plants in the row	Number of plants counted	Number of varieties included	Tillers per plant	
			Average number	Largest number				Average number	Largest number
Row not thinned	630	3	0. 20	2	1 every 6 inches	534	5	2. 68	8
1 every 2 inches	962	5	1. 15	7	3 every 9 inches	1, 032	5	1. 14	6
3 every 3 inches	1, 050	5	. 68	5	1 every 9 inches	402	5	2. 88	7
1 every 3 inches	788	5	1. 55	8	3 every 12 inches	777	5	1. 32	7
3 every 6 inches	969	5	. 78	7	1 every 12 inches	326	5	3. 27	12

It is often evident from observation that close planting reduces the average number of tillers per plant, and the results of this experiment are confirmatory of these observations.

QUANTITY OF SEED PER ACRE

When the planting is in continuous drills, 4 to 10 pounds of seed per acre are needed. Differences in quantity are due to differences in planters, in the size of the seed, in its viability, in the proportion of chaff on or intermixed with it, and in the moisture content and character of the soil at different periods. When the planting is at intervals in the row, the planter being regulated to drop approximately only enough seed to make the desired stand, no thinning being contemplated, 2½ to 5 pounds are needed. The average number of seeds per pound is about 25,000 or 30,000, varying with the variety, and there are between 25,000 and 50,000 plants per acre when the stand is complete. Two and one-half pounds therefore would be more than sufficient if every seed germinated and developed into a plant.

IMPORTANCE OF A UNIFORM STAND

Precautions should be taken as far as possible to have the stand complete and uniform throughout the field. When sorgo is cultivated for sirup the stand is of great importance, a poor stand resulting in decreased yields and more or less increase in the expense of growing, harvesting, and handling; whereas, when the stand is too thick the stalks do not develop to their full size, some of them often remaining grasslike. The quality of the sirup is also often lowered, because the stalks reach maturity unevenly. Further, the percentage of leaves is usually greater on small stalks and the expense of stripping, cutting, and handling is greater, especially when these operations are done by hand. Operators of small mills prefer stalks that are not too large in girth, because they are easily milled; but this is not the case when the crop is made up in a commercial factory, and large stalks are desired because they are more economical to handle.

Uniformity of maturity is of importance on account of the effect of an uneven development on the quality of the sirup. When the plants stand close there is always competition between them for plant food in the soil, and plants that begin growth first usually outgrow those germinating later. On this account such plants reach maturity and pass through their period of decadence somewhat earlier than the others. For this reason it is impossible to harvest the field at the most favorable time for all the stalks, and as a result the quality of the sirup may be lowered.

Poor stands result from inferior seed, from the soil being too cool for the best germination, from lack of soil moisture, from insufficient drainage, or from neglect of the crop. Although the plants tiller more abundantly and both the stalks and the tillers have a tendency to grow larger where the stand is scant (which partly compensates for the lack of plants in the row), frequently the stand is so poor that wide gaps occur. Sometimes, the gaps are replanted by hand at the time of the first cultivation of the field. This usually results in the crop's reaching maturity more or less unevenly; and it is usually a better practice, if the season is not too far advanced, to disk or replow and replant the entire field. In some cases it is practicable to fill in the gaps by transplanting young sorgo plants when thinning out the rows. If the plants are still small at the time of thinning and the soil is moist, transplanting can easily be done, and the stand can be made perfect. Care always should be taken when transplanting to raise a ball of earth about the roots of the young plant; and after it has been set all leaves except those of the greener inner whorl which have not yet reached complete development should be pinched off to about half or one-third their original length.

GROWTH AND DEVELOPMENT OF THE CROP

A steady uniform growth should be maintained in sorgo grown for the making of sirup. The sorghums, including both sorgo and the grain-producing varieties, without doubt withstand drought better than many species of plants. Nevertheless, when rainfall is deficient growth is usually checked, and though it may be resumed if rains occur later in the season, the tonnage of stalks is reduced in seasons in which the rainfall is either deficient or is poorly distributed throughout the growing period. If the dry period comes when the stalks are partly developed, the checking and the subsequent resumption of growth apparently has the effect of lowering the quality of sirup made.

Lack of moisture can be withstood much better at certain stages in the development than at others. Moisture is of course requisite for germination. If there is a deficiency, germination is almost certain to be poor, and the resulting stand scanty. Though seed may lie in the soil two weeks or more and then germinate if an abundant rain occurs, usually many of the seed lose their vitality if there is not enough moisture for germination within a short time after they are put into the ground. This is especially the case if the soil is slightly moist at planting time. This usually causes some of the seed to start to germinate and then die. Seedlings require less moisture than older plants, but they are not able to withstand prolonged dry periods, because their root development is scant. They sometimes suffer severely during dry periods and many die, this being most liable to happen if the stand has not been thinned and if early cultivation had not been given. During the time that the crowns of the plants are being formed and permanent roots are being put forth abundant moisture is requisite for maximum development. Observations covering a number of years indicate that a deficiency of moisture tends to result in stalks of small girth and a reduced tonnage. During the period that immediately follows the development of a permanent root system a deficiency of moisture can be withstood much better. The permanent roots absorb moisture from wider areas and somewhat lower levels than the temporary roots of the seedlings. This is especially true with late-maturing varieties, which in general grow more slowly, forming larger crowns and more extensive root systems than early-maturing varieties. Dry weather that comes when the plants are getting ready to put forth seed heads or slightly before has a tendency to delay development; but if the dry period comes just as the heads are about to emerge, it often causes premature development. The heads sometimes do not get out of the sheaths and do not produce seed. In other cases, they get partly out and a small quantity of seed is produced. As the head terminates the elongation of the stalk, subsequent growth is by the production of branches, which are of no value for sirup making.

Internodes formed when growth is retarded are somewhat shorter than those formed when conditions are normal. The proportion of nodes to internodes is therefore greater, and this is evidently one reason why stalks that develop slowly or intermittently yield sirup inferior in quality. Tests that have been made have indicated that juice from the nodes is darker and contains less sugar and more impurities than juice from the internodes. This is shown in Table 2, giving the results of separate analyses of the nodes and the internodes of three varieties, and it will be noted that in the case of each variety the percentage of sucrose and the percentage of total sugars was greater in the internodes than in the nodes. The columns headed "Total sugars ÷ Brix" indicate the relative purity of the juices in regard to sugars contained, the average for the juices from the nodes being 77.7 per cent and that for the juices from the internodes 81.8 per cent. Juices from the nodes were a dark greenish color, whereas those from the internodes were a light greenish yellow, and the latter were clearer than the former.

TABLE 2.—*Chemical analyses of the juices from the nodes and the internodes of three varieties of sorgo*

Variety	Analyses of the juice of the nodes					Analyses of the juice of the internodes				
	Density [1]	Sucrose [1]	Reducing sugars [1]	Total sugars	Total sugars ÷ Brix [1]	Density [1]	Sucrose [1]	Reducing sugars [1]	Total sugars	Total sugars ÷ Brix [1]
	° Brix	*Per cent*	*Per cent*	*Per cent*		*° Brix*	*Per cent*	*Per cent*	*Per cent*	
Red X	21.80	13.52	2.80	16.32	74.9	22.40	16.17	1.51	17.68	78.9
Sugar Drip	20.90	12.71	4.35	17.06	81.6	20.80	14.38	3.32	17.70	85.1
White African	21.30	13.02	3.32	16.34	76.7	21.40	15.54	1.85	17.39	81.3
Average	21.33	13.08	3.49	16.57	77.7	21.53	15.36	2.23	17.59	81.8

[1] "° Brix" indicates the density of the juice as determined by the Brix hydrometer, or the percentage of total solids in solution. "Sucrose, per cent" indicates the percentage in the juice of the easily crystallizable sugar, sucrose, frequently called cane sugar. "Reducing sugars, per cent" indicates the combined percentages of the two sugars, dextrose and levulose, both of which, in addition to sucrose, usually occur in sorgo juice. "Total sugars ÷ Brix" indicates the relative purity of the juice with regard to the sugar contained.

Regarding other climatic factors, for optimum growth sorgo needs rather high temperatures, together with abundant sunshine, from the time of planting until about the time of heading. After that stage moderately cool temperatures are desirable. Very hot periods coming in the latter part of the growing season, especially if accompanied by a deficiency of rainfall, often have a pronounced deleterious effect. The stalks lodge and deteriorate rapidly thereafter. Chemical tests indicate that such stalks are prematurely ripe, their composition resembling that of stalks that have ripened normally. It is then advisable to commence making up the crop immediately, since many of the stalks are liable to decay and a part of the crop may be lost. This does not apply, however, to certain varieties that always have a tendency to lodge before becoming completely mature.

A single light frost usually results in no serious injury to the growing crop. The extent of the injury may be only that the extremities of the leaves are withered, or these may subsequently dry up. But if a heavy frost occurs when the plants are immature, or if even light frosts occur repeatedly at short intervals, the plants will be injured and their vitality will generally be so lowered that deterioration will follow, this commonly being accompanied by an inversion of some of the sucrose—in other words, the changing of the sucrose into dextrose and levulose—and in some cases by a lowering of the specific gravity of the juice.

Degeneration due to frosts is always evident to the sirup maker, as the juice gives off a putrid odor when heated. The relative degree of injury sustained by stalks in varying stages of development will be evident to anyone who examines a field after a few days of warm weather have elapsed following a severe frost. The more immature stalks fall over. The effect on composition will be noted by comparing the figures in the columns of Table 3 showing the percentages of sucrose and of reducing sugars and the specific gravity of the juice of 26 varieties, both before and after October 6 and 11, at which dates frosts occurred. Cases in which the effects were not marked, as shown by the analyses, can be attributed to the fact that the stalks had gotten well along toward maturity before frosts occurred.

TABLE 3.—*Effect of frost on sorgo juices*[1]

[Heavy frosts occurred on October 6 and 11]

Variety	Just before Oct. 6 and 11						Just after Oct. 6 and 11					
	Juice extracted and sugars and solids not sugar in the juice				Specific gravity of juice	Equivalent readings	Juice extracted and sugars and solids not sugar in the juice				Specific gravity of juice	Equivalent readings
	Juice extracted	Sucrose[2]	Reducing sugars[2]	Solids (not sugar)			Juice extracted	Sucrose[2]	Reducing sugars[2]	Solids (not sugar)		
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*		°*Brix*[2]	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		° *Brix*[2]
1	54.28	15.24	0.87	2.76	1.078	18.80	57.90	14.32	1.16	4.60	1.078	18.80
2	51.18	13.56	1.39	2.15	1.073	17.70	57.93	14.12	1.18	4.14	1.075	18.15
3	44.54	16.32	1.08	2.74	1.087	20.80	55.81	16.59	1.09	5.11	1.088	21.05
4	55.10	11.85	1.11	3.05	1.068	16.55	55.80	16.24	1.27	4.20	1.082	19.70
5	51.31	12.58	.70	2.40	1.068	16.55	57.44	14.65	.40	5.03	1.078	18.80
6	58.06	15.36	.98	2.88	1.082	19.70	52.07	13.97	3.28	4.33	1.084	20.15
7	59.89	14.77	1.31	3.65	1.082	19.70	58.13	11.99	1.16	3.73	1.069	16.75
8	48.46	17.22	.95	2.94	--------	--------	55.23	13.88	2.44	3.97	1.084	20.15
9	61.19	12.54	2.12	2.58	1.070	17.00	58.00	13.24	1.85	3.45	1.076	18.35
10	58.02	17.38	.51	4.12	1.090	21.50	54.60	16.30	.40	3.80	1.085	20.40
11	57.25	16.89	.42	3.38	1.085	20.40	52.91	16.13	.59	4.87	1.088	21.05
12	55.58	17.40	.78	-------	1.089	21.30	47.38	13.90	1.78	4.44	1.081	19.50
13	55.84	16.57	1.52	3.14	1.083	19.95	58.99	14.72	1.64	2.50	1.079	19.05
14	55.99	18.15	1.39	4.40	1.094	22.40	56.95	13.55	1.50	3.59	1.078	18.80
15	49.29	16.68	1.56	-------	1.089	21.30	58.07	14.39	1.73	2.93	1.081	19.50
16	46.29	14.14	2.60	3.67	1.080	19.25	58.51	15.25	1.96	2.01	1.082	19.70
17	53.87	16.10	.94	4.20	1.085	20.40	58.75	15.60	1.20	3.47	1.085	20.40
18	57.97	15.78	1.26	4.01	1.083	19.95	65.80	12.41	2.57	1.81	1.069	16.75
19	55.99	15.77	1.72	4.23	1.084	20.15	60.34	12.44	3.02	2.63	1.075	18.15
20	51.72	15.91	1.27	3.66	1.082	19.70	62.71	9.45	1.58	2.31	1.053	13.05
21	57.28	14.55	2.31	3.11	1.079	19.05	67.31	4.64	4.77	2.61	1.048	11.90
22	57.98	16.22	1.66	4.17	1.088	21.05	56.11	10.19	2.46	3.28	1.067	16.30
23	63.72	11.70	4.14	2.74	1.071	17.20	59.73	6.50	3.98	2.97	1.052	12.80
24	56.77	16.35	1.20	4.15	1.085	20.40	64.03	7.27	1.07	3.14	1.045	11.15
25	52.94	14.86	1.50	3.27	1.082	19.70	60.39	12.15	1.92	1.96	1.071	17.20
26	-------	13.50	1.43	3.34	1.078	18.80	59.51	11.69	1.28	4.00	1.066	16.10
Average	54.82	15.28	1.41	3.36	1.0814	19.57	58.09	12.91	1.82	3.49	1.0738	17.83

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[1] Reproduced from U. S. Dept. Agr. Rpt. 1881–82: 459–460. Columns showing "Equivalent readings (° Brix)" have been added.

[2] See footnote 1 to Table 2, p. 17.

The effects of unfavorable conditions can not always be prevented, but very often it is possible at least to hold them to a minimum. Cultural practices as far as possible should be those that will promote steady and uniform development from the time the seed germinates until the stalks have reached the proper stage for harvesting, uniform growth being especially desirable during the time that the stalks are being formed. Furthermore, the grower should always take advantage of any signs indicating that the crop is about to undergo deterioration when approaching maturity. By promptly harvesting it may be possible to prevent losses of tonnage and save the quality of the sirup.

CULTIVATION

The cultivation of sorgo should be similar to that of corn; but the plants are smaller than corn plants of the same age, and it is necessary to take greater precautions against the growth of weeds and to exercise greater care to prevent the plants being broken. Usually there are many more sorgo plants in the row than there are corn plants. The purposes of cultivation are primarily to destroy weeds and to keep the soil open for the absorption of moisture.[7]

Cultivation should start soon after the plants are up, especially if there have been rains that would cause weed seed to germinate. Implements with a number of small shovels or teeth are more suitable for early cultivation than those equipped with larger shovels. They are less likely to cover or break the plantlets, and they leave the soil in better physical condition. It is sometimes possible to cross harrow the field with a spike-tooth harrow after the plants are through the surface, but on soils that have a tendency to crust after rains great care must be taken to prevent breaking the plants by the movement of the crusted soil. The early cultivation may be done with a weeder; with a light 1-horse harrow, harrowing with the rows; with a 1-horse cultivator; with a 2-horse, single-row cultivator; or with a 2-row cultivator. (Fig. 4.) These implements may be equipped with teeth, with small shovels of the type frequently called "bullock's tongue" shovels, or with other small shovels. Disk cultivators are also often employed with good results, and in some parts of the South the cotton scrapers are used when the rows are on ridges. Both shovels and disks should be set to work as close to the rows as possible without causing injury to the plants, and where cultivators with shovels are used they should be equipped with fenders to prevent covering and breaking the plants.

Cultivation may be somewhat deeper during early stages than later, as root development is then not extensive; but next to the rows deep cultivation should not be practiced and would be of little value, especially if the field was well prepared. In the middles the early cultivations may be deeper than next to the rows, and moderately deep cultivation may often be continued there without causing injury until the crop is about ready to lay by. This depends much upon the variety.

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[7] Certain perennial weeds that require special treatment for their eradication grow abundantly in some localities where sorgo is cultivated for sirup making. Among these, Johnson grass and Bermuda grass are the worst. Johnson grass, belonging to the sorghum group of plants and being self-propagating by means of underground rootstocks, is very objectionable, because it provides a means for carrying over from one season to another fungous diseases and insect pests that attack sorgo. (See pp. 36–38.) Sorgo undoubtedly also crosses naturally with Johnson grass, and this sometimes causes a deterioration of seed stocks. For means of eradication of these grasses the reader is referred to the following publications:

CATES, J. S., and SPILLMAN, W. J. A METHOD OF ERADICATING JOHNSON GRASS. U. S. Dept. Agr. Farmers' Bul. 279, 16 p., illus. 1907.

HANSEN, A. A. ERADICATION OF BERMUDA GRASS. U. S. Dept. Agr. Farmers' Bul. 945, 12 p., illus. 1923. (Revised.)

The cultivation may be level or the rows may be hilled or ridged. Weeds growing in the row may be effectively destroyed if the cultivator shovels are set so that they throw some soil toward the row. For this purpose a certain amount of hilling is justifiable. Hilling is also justified by some growers in that it promotes drainage of the field and gives the stalks a more secure anchorage, so that they can better withstand severe winds without becoming lodged.

In many cases hilling is carried to an extreme. The rows have a greater tendency to dry out during dry periods when hilled than when not hilled, and the cultivation is in general more expensive, especially if the ridges are made high. It is then necessary to make a separate trip across the field to cultivate each row and each middle; whereas, when the cultivation is level a man and team with a properly adjusted cultivator will cultivate at least a row and half a middle on each side at each trip across the field. Further, when the soil is shallow some subsoil is often thrown from the middles on the ridged rows at each cultivation, with the result that the fertility of the field is lowered to a certain extent.

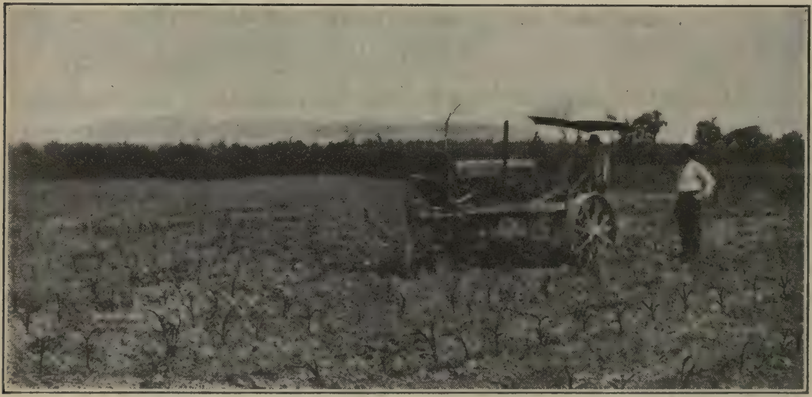

FIGURE 4.—A motor-driven 2-row cultivator

The number of cultivations that can be given economically will vary with the time of the planting, the variety, the length of the season, and climatic conditions. On the average three to six cultivations will be needed to keep weeds in check. As sorgo grows more rapidly when planted late, fewer cultivations are then needed than for an early-planted crop. Early-maturing varieties grow more rapidly than late-maturing ones and shade the soil sooner. They therefore require fewer cultivations.

HOEING AND THINNING

Hoeing, while not always necessary, in many instances can not be avoided, in order either to destroy weeds growing in the rows or to thin the stand. Even when the seed is planted in hills it is not always possible to regulate the planting so that just the desired stand will be secured, and when the planting is in continuous drills some thinning is necessary as a rule. The earlier the thinning can be done the better for the crop. The plants may be thinned at any time after they are about 2 inches high, and thinning should always be done before tillers are first put forth. The plants that are left then do not suffer so much, and thinning may be more easily and cheaply performed at that time. The plants are not so strongly rooted and the crowns are not so deeply covered as they are later. It is the custom with some growers to do the hoeing and thinning before the first cultivation. This is a good practice if the field is not unduly weedy. Some growers, however, prefer always to give a preliminary cultivation, barring off the row or turning the soil away from it, following this immediately with the hoeing. As hoeing removes some of the earth from the crown and roots, the field should be cultivated as soon as possible thereafter, in order to return soil to the plants to prevent rapid evaporation.

HARVESTING

TIME OF HARVESTING

The point in its development at which the crop should be harvested is one of the most important matters the grower has to decide and should be given careful consideration. The composition as well as the soundness of the stalks (and for that reason the quality and the quantity of sirup obtained) changes more or less with the progress toward maturity. After the stalks attain about their full size, maturity of the entire plant advances at about the same rate as the maturity of the head. The plants are generally considered mature when the seeds are hard. From the viewpoint of the sirup maker this is not always a good indication of maturity, as ripeness of the seed does not necessarily indicate ripeness of the stalk. These differences depend upon varieties and climatic conditions from one year to another. The stalks should be considered ripe when the largest yield of sirup of prime quality can be made from the juice, and this is partly determined by each of the following factors: The quantity of juice extractable; the percentage of solids contained; the ratio of sucrose to reducing sugars in the juice; the ease with which the juice can be freed from impurities (to a large extent determining the quantity of soluble solids that will be lost in the process of making the sirup, especially in home manufacture) ; and the soundness of the stalks. All of these factors change more or less with the advance in maturity of the plants.

The quantity of extractable juice varies less than the yield of stalks per acre or the percentage of sugars in the juice. This is especially the case when the stalks are ground in the type of mill commonly a part of the home outfit. The larger mills used by commercial factories, which usually consist of three units of three steel rolls each, are more efficient, and crops show greater differences in regard to the percentage of juice when ground in the factory mill than in a farm mill. The stalks, however, tend to become less juicy after they reach complete maturity (see Table 4, last two analyses), and there is a loss of juice in dry weather, the latter also being most apparent after maturity. On the other hand, excessively humid seasons may cause increases in juiciness. In many cases differences in juiciness are not shown by the percentage of juice that is obtained. This is due to the fact that the total weight of the stalk is reduced by any drying that takes place and is increased in humid periods and that the stalks tend to become softer after they pass the mature stage, so that it is easier to crush out the juice.

In regard to composition, some sucrose is present in the stalks in the early stages of development. This as well as the percentage of total sugars and percentage of solids not sugar gradually increases, as is shown in Table 4, giving the averages of the analyses of about 45 varieties. The same is also in general true with regard to the ratio of sucrose to reducing sugars. It will be observed from the table that the highest content of sugars was reached some time after the seeds had become completely hard and that afterwards there was a decline.

TABLE 4.—*Composition of sorgo juice at different stages of development of the stalks*[1]

Stage of development of the crop	Analyses made in—				Average results, 1879, 1880, and 1881					
	1879	1880	1881	Total	Juice extracted and sugars and solids not sugar in the juice				Specific gravity of juice	Equivalent readings
					Juice extracted	Sucrose[2]	Reducing sugars[2]	Solids (not sugar)		
	No.	*No.*	*No.*	*No.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		° *Brix*[2]
About 1 week before the panicle opened	------	58	16	74	60. 41	1. 57	3. 86	1. 89	1. 028	7. 05
Immediately before the panicle opened	2	69	38	109	62. 26	2. 32	4. 03	2. 05	1. 032	8. 05
Panicle just appearing	------	57	40	97	63. 71	2. 82	4. 02	2. 04	1. 033	8. 30
Panicle two-thirds out	------	70	52	122	64. 34	3. 35	3. 94	2. 33	1. 035	8. 75
Panicle entirely out; no stem above upper leaf	8	75	46	129	65. 00	4. 23	3. 89	2. 36	1. 043	10. 70
Panicle beginning to bloom at the top	4	62	51	117	65. 17	5. 16	3. 88	2. 58	1. 045	11. 20
Flowers all out; stamens beginning to drop	4	70	42	116	65. 11	6. 39	3. 85	2. 41	1. 048	11. 90
Seed well set	4	111	42	157	66. 25	7. 23	3. 80	2. 53	1. 053	13. 05
Seed entering the milk stage	4	266	45	315	65. 15	8. 74	3. 26	2. 44	1. 057	14. 00
Seed becoming doughy	8	217	60	285	65. 49	9. 69	2. 76	2. 50	1. 060	14. 70
Seed doughy; becoming dry	12	166	53	231	65. 22	10. 53	2. 50	2. 72	1. 062	15. 15
Seed almost dry, easily crushed	10	170	44	224	63. 19	11. 41	2. 19	2. 84	1. 066	16. 10
Seed dry, easily split	8	183	40	231	62. 90	11. 75	2. 09	2. 82	1. 068	16. 55
Seed split with difficulty	8	191	37	236	61. 26	12. 13	1. 92	2. 95	1. 068	16. 55
Seed split with more difficulty	4	217	37	258	60. 90	12. 09	1. 87	3. 11	1. 068	16. 55
Seed split with still more difficulty	6	339	40	385	61. 10	12. 79	1. 65	3. 28	1. 071	17. 20
Seed harder	6	197	37	240	59. 98	14. 07	1. 57	3. 92	1. 078	18. 80
Seed still harder (1)	2	191	45	238	61. 03	12. 80	1. 71	3. 34	1. 071	17. 20
Seed still harder (2)	12	30	44	86	56. 74	14. 01	2. 18	3. 31	1. 080	19. 30
Seed still harder (3)	22	------	370	392	58. 45	11. 95	1. 72	3. 81	1. 069	16. 75
Total	124	2, 739	1, 179	4, 042	-------	-------	-------	-------	-------	--------

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[1] Reproduced from U. S. Dept. Agr. Rpt. 1881–82: 452. The right-hand column, giving specific-gravity equivalent in Brix hydrometer readings, has been added.

[2] See footnote 1 to Table 2, p. 17.

With reference to sirup quality, it should be noted that after reaching maturity the stalks tend to degenerate, and that when the crop is harvested and made up after such degeneration has commenced the sirup is almost invariably of stronger flavor and darker color than when the crop is harvested and made up at the proper time. Only a slight deterioration in a part of the stalks may affect both flavor and color. On the other hand, in cases where the stalks are harvested young, it is often difficult to free the juice from natural impurities which, if not eliminated, tend to impart objectionable flavors and colors. Some sirup makers are proficient in eliminating impurities from the juice of even comparatively young stalks. When this object is accomplished the sirup is as a rule milder and lighter in color than sirup made from older stalks.

In order to determine sweetness some growers resort to tasting the stalks. Nothing but a very rough estimate can be arrived at in this way—owing partly to the presence of three kinds of sugar, varying in proportions at different stages of development of the crop and possibly to a certain extent under different conditions of growth—but many growers are able to judge with considerable accuracy when the proper time for harvesting has been reached simply from the appearance of the crop, considered from the viewpoints of both quantity and quality of the product. A more accurate method is from time to time to take samples of stalks from the field and to determine the density of juice expressed from them by means of a hydrometer. Figure 5 is an illustration of a hydrometer. The density of the juice, not its actual sugar content, is indicated by the hydrometer, but density and sugar content are closely correlated,

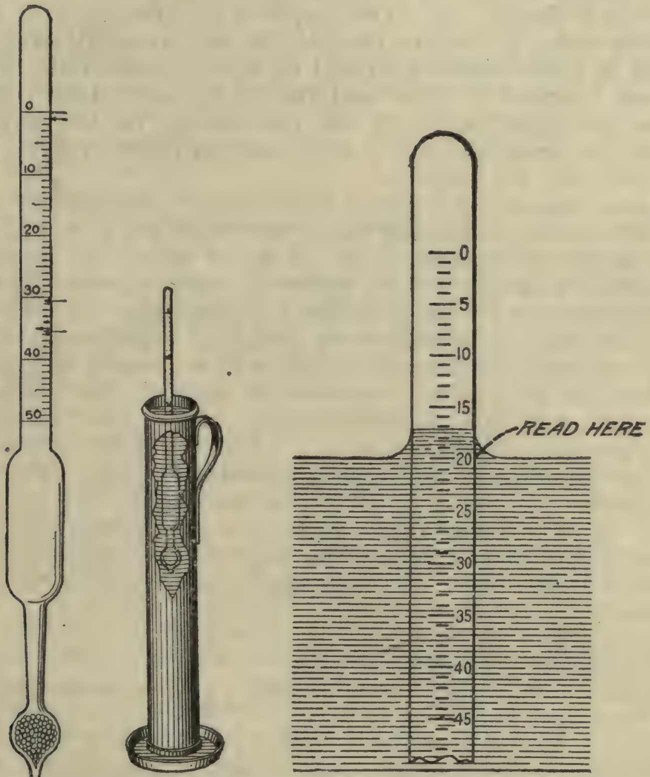

FIGURE 5.—A hydrometer, showing the instrument suspended in a cylinder of juice and the point on the scale at which the reading should be made

and the method is reliable enough to be of considerable value. With a little practice a grower or sirup maker can become proficient enough in the use of the hydrometer for ordinary purposes.

In taking the samples care should always be exercised to have them as nearly as possible representative of the entire field. The stalks should be gotten at random and should be of average size and in average stage of development. A sample large enough to be fairly representative of the field as a whole should be taken. An effort should be made to have the proportion of tillers to initial stalks correspond with that of the entire field. If possible, the sample should be passed through a mill immediately after having the leaves removed and being cut. The expressed juice should then be strained, in order to remove the coarser substances floating or suspended in it, after which it should be tested in the following manner: A tall cylinder is filled and the hydrometer floated freely in it. When the latter comes to rest the reading on the scale at the surface of the juice is noted. (See scale at right in fig. 5.) This reading indicates the density.

There are a number of kinds of hydrometer. The Baumé hydrometer, which is very commonly used for rough sugar work, is graduated in degree from zero to 50. Table 5 shows the approximate percentages of water and of dry matter in solution when the readings on the Baumé scale are made at the standard temperature, 63½° F. As the substances in solution consist mainly of sugars, with only small quantities of other substances, all of which become a part of the sirup when the juice is concentrated by boiling, the density determined in this way is a rough indication of the yield of sirup that may be expected. Juice that shows a density of 11° Baumé at the temperature of 63½° should be considered very good. The juice of many varieties will, in fact, not reach that point during the entire season; 9° or 10° Baumé is as high as can be expected from a large number of varieties, and the grower will need to learn from experience with the variety he cultivates the maximum density that may be expected.

TABLE 5.—*Dry substance and water corresponding to each degree Baumé*

[The figures in the "Dry-substance" column correspond to the figures for degree Brix given in Tables 2, 3, 4, 6, and 7 of this bulletin]

Degrees Baumé [1]	Dry substance	Water	Degrees Baumé [1]	Dry substance	Water	Degrees Baumé [1]	Dry substance	Water
	Per cent	*Per cent*		*Per cent*	*Per cent*		*Per cent*	*Per cen.*
1	1.7	98.3	18	32.1	67.9	35	63.9	36.1
2	3.5	96.5	19	33.9	66.1	36	65.8	34.2
3	5.3	94.7	20	35.7	64.3	37	67.8	32.2
4	7.0	93.0	21	37.5	62.5	38	69.7	30.3
5	8.8	91.2	22	39.4	60.6	39	71.7	28.3
6	10.6	89.4	23	41.2	58.8	40	73.7	26.3
7	12.3	87.7	24	43.1	56.9	41	75.7	24.3
8	14.1	85.9	25	44.9	55.1	42	77.7	22.3
9	16.0	84.0	26	46.8	53.2	43	79.7	20.3
10	17.7	82.3	27	48.6	51.4	44	81.8	18.2
11	19.5	80.5	28	50.5	49.5	45	83.8	16.2
12	21.3	78.7	29	52.4	47.6	46	85.9	14.1
13	23.0	77.0	30	54.3	45.7	47	88.0	12.0
14	24.8	75.2	31	56.2	43.8	48	90.1	9.9
15	26.6	73.4	32	58.1	41.9	49	92.2	7.8
16	28.4	71.6	33	60.0	40.0	50	94.4	5.6
17	30.3	69.7	34	61.9	38.1			

[1] Taken at 63½° F.

STRIPPING OFF THE LEAVES AND REMOVING THE HEADS

When the crop is made up with a farm outfit, stripping off the leaves should be the first operation of the harvesting. A field of stripped sorgo is shown in Figure 6. The leaves should be removed on account of the large amount of undesirable matter contained in them, especially green chlorophyll, which occurs in all green plants. For home manufacture the stripping should be done while the stalks are standing. The leaves may be struck off with a paddle, or with the cane knife that is used for cutting, or pulled off with the hands. Special stripping tools, such as are sometimes used for stripping sugarcane, are not generally in favor for stripping sorgo. The bases of the leaves, or leaf sheaths, cling tightly around the stalks, not being shed off like those of many varieties of sugarcane, and can not readily be removed. These leaf sheaths remain, therefore, except in cases where growers clean them off with a knife, which is a slow process and not often followed. All branches as far as possible should be removed.

Commercial companies usually purchase the stalks unstripped. The leaves are removed by machinery just before grinding. In some factories the process consists of cutting the stalks with leaves attached into short lengths by means of a power-driven knife, and then agitating the mass of pieces of stalks, leaves, and leaf sheaths before a current of air. The leaf sheaths are more thoroughly eliminated in this way than can be done by stripping in the field.

In some instances stalks have been ground without stripping, and growers have reported success from this procedure. Greater evaporating capacity than is ordinarily employed is advisable when this procedure is followed, in order to afford greater opportunity for skimming off impurities.

The leaves, even when partly dried, contain extractable juice or sap which contains sugar. A sample of leaves passed separately through a 3-roller mill yielded 18.07 per cent of juice which showed a density of 10.67° Brix, and two varieties tested with and without leaves gave results as shown in Table 6, in which it will be noted that in the case of both varieties approximately 2 per cent more juice was obtained from the unstripped than from the stripped stalks. The percentage of sugars was somewhat less in the juice from the unstripped stalks, but the difference is negligible from a sirup-making standpoint. One investigation indicated 15.8 per cent more juice and 3.1 per cent more sirup from stalks not stripped than from stripped stalks, but it appears from the results of the recent tests that in general additional sirup obtained would not be sufficient to be significant.

A certain amount of sugar would be lost in skimming off additional impurities introduced with the leaf sap, although when the plants are past mature, especially if the leaves have been withered by frosts, the quantity of undesirable matter pressed out would be smaller than earlier in the season. The important point, however, especially for the small producer, is that stripping requires much time and adds to the expense of harvesting. If sirup of good quality can be produced from unstripped stalks it is an advantage from the viewpoint of economy.

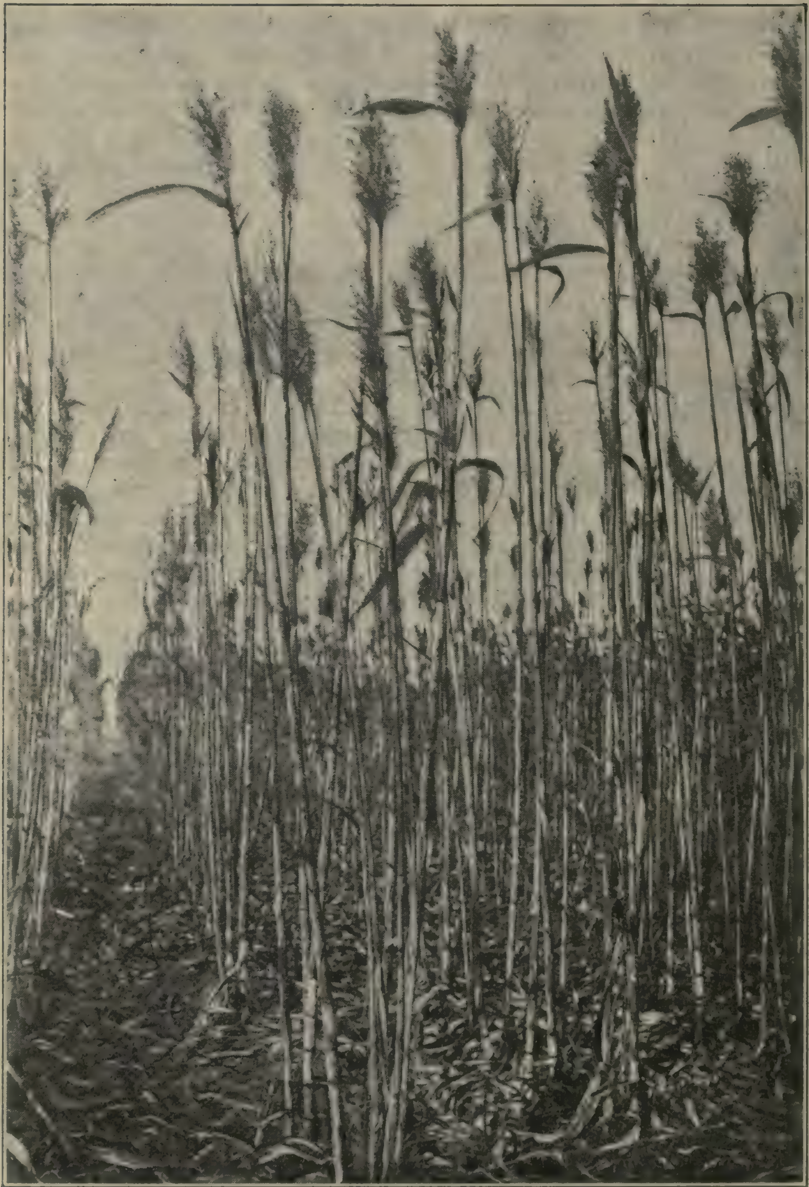

FIGURE 6.—A field of sorgo plants stripped for grinding

TABLE 6.—*Analyses of the juice of two varieties of sorgo stripped and unstripped*

Variety	Juice extracted	Density of juice [1]	Sugars in the juice			Total sugars ÷ Brix [1]
			Sucrose [1]	Reducing sugars [1]	Total sugars [1]	
	Per cent	*°Brix*	*Per cent*	*Per cent*	*Per cent*	
Jones (stripped)	50. 18	19. 35	13. 14	2. 80	15. 94	82. 4
Jones (not stripped)	52. 23	18. 20	11. 75	2. 84	14. 59	80. 2
White African (stripped)	48. 36	21. 30	14. 33	2. 45	16. 78	78. 8
White African (not stripped)	50. 50	20. 65	13. 60	2. 54	16. 14	78. 2

[1] See footnote 1 to Table 2, p. 17.

Sorgo seed contains large quantities of starch as well as other impurities. All heads, including those that have not emerged, should be removed. They may be cut off with a knife while the stalks are standing, but if the stalks are left in piles with the heads all in one direction the heads can be removed more easily. When the crop is made up in a factory the heads in most cases are removed after the stalks have been received and just previous to the grinding. This operation is often performed by means of some mechanical appliance. (Fig. 7.)

There is sometimes uncertainty in the minds of growers as to how much, if any, of the top of the stalk should be cut off with the head. The last internode or peduncle generally contains less soluble solids than the remainder of the stalk. A test (Table 7) showed a lower percentage of juice as well as a lower percentage of soluble solids in each of three varieties in the case of the peduncles than in the remainders of the stalks. The averages were as follows: Average extraction of juice from peduncles, 45.26 per cent; from the remainders of the stalks, 55.68 per cent; average solids in juices from peduncles, 11.35 per cent; from the remainders of the stalks, 15.24 per cent. Of more importance is the fact that the peduncle and the adjoining internodes frequently deteriorate before the remainder of the stalk shows any sign of deterioration. Juice from these parts is then dark and more or less ill flavored. When there has been deterioration in these parts it is advisable to remove the entire peduncle and the affected internodes as well.

At one time it was thought that if the heads were removed before maturity it had a tendency to increase the proportion of sugar in the stalk; but results of a number of experiments have shown that although the maturity of the plant is advanced by removing the head the maximum quantity of sugar that ultimately would be obtained is not increased.

CUTTING

Small areas grown for a home supply of sirup are usually cut by hand. A corn knife or one of the types of knife employed in the Gulf States for cutting sugarcane is used. Large acreages are also sometimes harvested in this way. As the stalks are cut they should be laid in or across the rows, preparatory to being hauled. When three or four men are working together, the cutting and the loading upon wagons, if desired, can be done simultaneously. A hoe then can be used to advantage for the cutting, one man operating the hoe and the others grasping bunches of stalks as they are cut and loading them on the wagons, which are driven along just outside the row that is being cut.

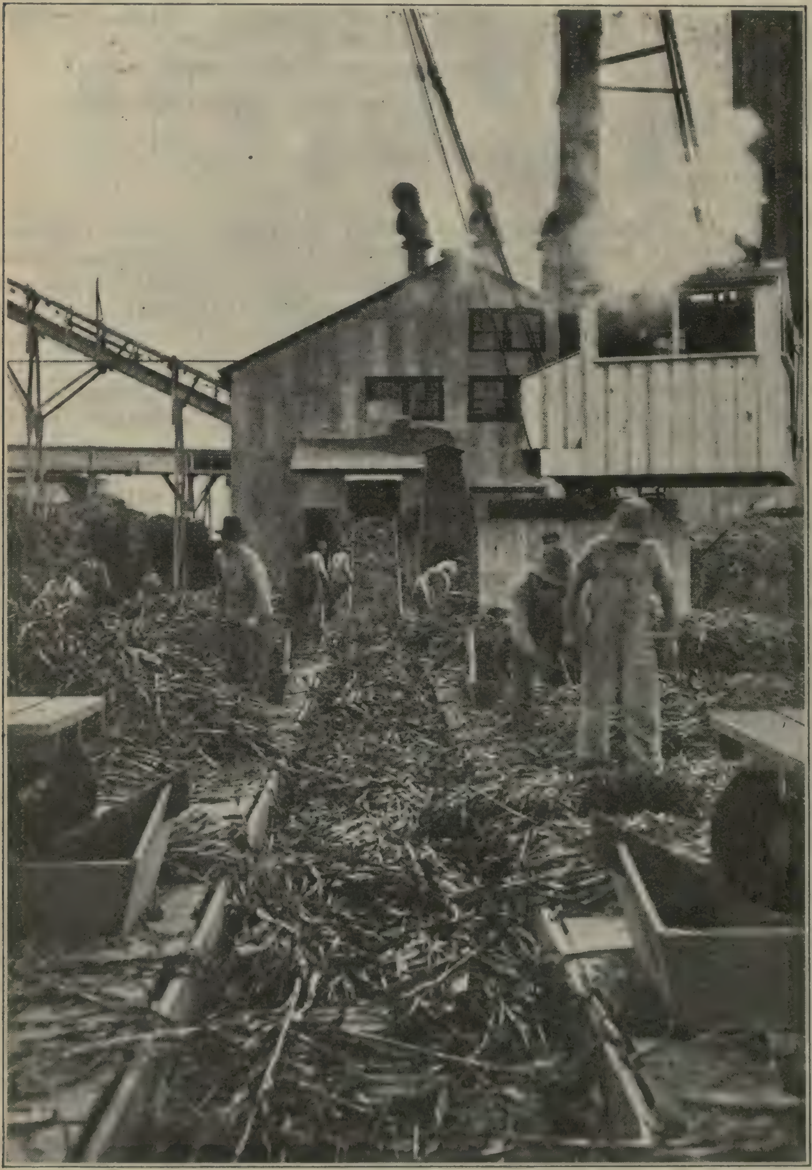

FIGURE 7.—Rotating saws used for removing heads from sorgo stalks

The corn harvester (fig. 8) can often be used to advantage for cutting large fields, unless the stalks have lodged badly. Some growers remove the binder attachment, so that the stalks are thrown off in bunches but are not bound. Other growers think it advantageous to have the stalks bound, for sake of convenience in handling. The common sled corn cutter is also sometimes used for the cutting, being operated the same as when cutting corn.

As a usual thing, unless deterioration has taken place it is advisable to cut the stalks close to the surface of the ground, as when they are cut higher there is a loss of tonnage, and an increased amount of stubble is left on the field; but if considerable deterioration has taken place in the bases of the stalks, or if there has been considerable growth of aerial roots at the bases, it is better to cut high enough to leave the discolored or rooty portions, else it will be necessary to remove these afterwards to prevent lowering the quality of the sirup.

The lower internodes of the stalk as well as the upper internodes frequently contain smaller quantities of juice and smaller quantities of soluble solids extractable than the internodes in the middle of the stalk. This, it will be noted, was the case in the tests reported in Table 7, in the making of which a 3-roller power-driven mill was used. With each variety small quantities of juice and of soluble solids were obtained from the lower internodes, as well as from the upper ones, than from those in the middle. The analyses of the first two varieties were made after the seed had become hard; in the case of the third the seed was in the milk stage. The probable explanation of the points brought out is that the basal internodes are the oldest and those at the top the youngest, the internodes tending to reach maturity in the order that they were formed. It is sometimes found that the lower internodes have commenced to deteriorate some time before the internodes in the middle and those above the middle show signs of deterioration, due to the fact that they are older.

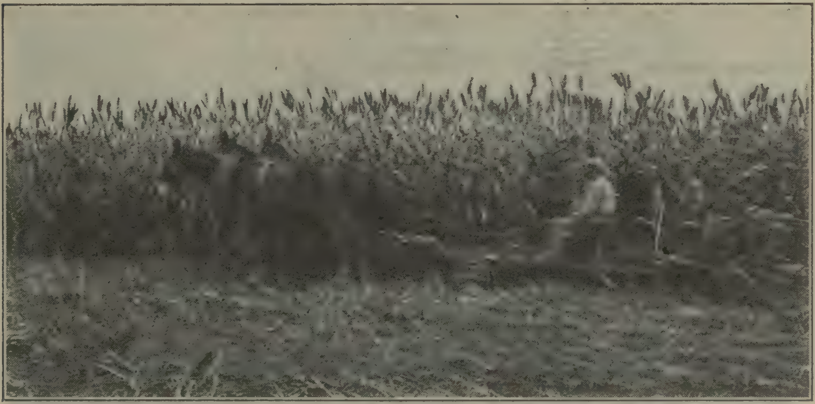

FIGURE 8.—Cutting sorgo with a corn harvester. The variety is Red X

The lower internodes are as a rule also shorter than those in the middle, the proportion of nodes to internodes being consequently greater at the base. It appears from tests made that the nodes contain less sugar and more impurities than the internodes, this being shown in Table 2 giving separate analyses of the nodes and internodes of three varieties. On this account the juice from the bases often contain less sugar and more impurities than juice from the middle internodes.

TABLE 7.—*Percentages of juice and of solids in solution from different parts of the sorgo stalk*

Variety	Three lower internodes		Middle internodes		Three upper internodes		Peduncles	
	Juice extracted	Density of juice [1]	Juice extracted	Density of juice [1]	Juice extracted	Density of juice [1]	Juice extracted	Density of juice [1]
	Per cent	°*Brix*	*Per cent*	°*Brix*	*Per cent*	°*Brix*	*Per cent*	°*Brix*
Red X	49.18	20.26	54.13	20.36	47.82	19.83	43.54	14.71
Sapling	52.19	17.27	57.77	16.66	53.84	14.26	44.87	10.47
Indiana Amber	60.49	9.48	63.72	9.56	62.05	9.53	47.36	8.86
Average	53.95	15.67	58.54	15.53	54.57	14.54	45.26	11.35

[1] See footnote 1 to Table 2, p. 17.

HANDLING THE CROP

In case the crop is harvested without being stripped, it should be allowed to remain in the field for a time, so that the leaves may partly cure, otherwise some fermentation and heating is liable to take place in the foliage after the stalks are hauled from the field and put into shocks or piles preparatory to grinding. This is especially liable to occur if the weather is warm. Some growers think it also advisable to allow stripped stalks to cure to a certain extent after being cut and before they are passed through the mill; but as a general rule the crop should be made up within a few days. Some deterioration will take place in mature stalks if they are not soon ground, and there will be a loss of moisture and a consequent loss in weight, especially if the stalks are not sound and have not been well shocked or piled. (Fig. 9.) The loss will become evident not only in the weight of the stalks but also in the percentage of juice extracted. There may be an increase in the percentage of sugars in the juice, due to concentration as a result of the drying out of the stalks; but eventually the amount of sugars that can be gotten out, and for that reason the quantity of sirup that can be made, will be reduced.

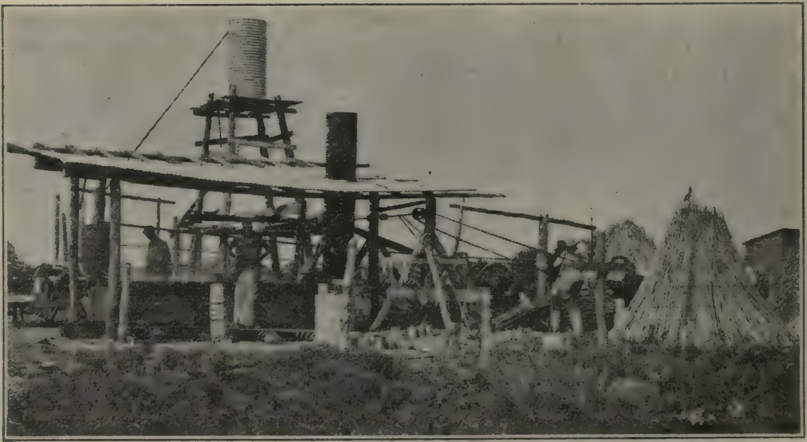

FIGURE 9.—A farm sirup-making outfit, showing sorgo stalks in shock for grinding

Shocking, if done early enough, tends to retard, though it does not entirely prevent, natural deterioration of the stalks in the field due to senescence, or aging. It also to a great extent prevents rapid deterioration of partly mature stalks after severe frosts. In case the crop can not be made into sirup immediately, because of the demands of other work, it is sometimes cut and shocked in the field and is made up when opportunity is afforded. Shocking in the field is, however, not generally a good practice. Some deterioration takes place in shocked stalks, especially in warm weather, the percentage extraction of juice is lowered, and the expense of harvesting is increased. The advisability of shocking will depend on the ability of the variety to withstand deterioration, the condition of the crop, and the probability of frosts.

For hauling, low wagons, preferably with broad wheels and broad, flat beds extending over the wheels (fig. 10), are better than ordinary wagons equipped with ordinary beds or with hayracks. When the haul is a long one, motor trucks can often be used to advantage. Large 2-wheeled dump carts are employed for hauling sugarcane in the Tropics, the dumping feature saving the labor of unloading; and similar carts might be used to advantage for hauling sorgo.

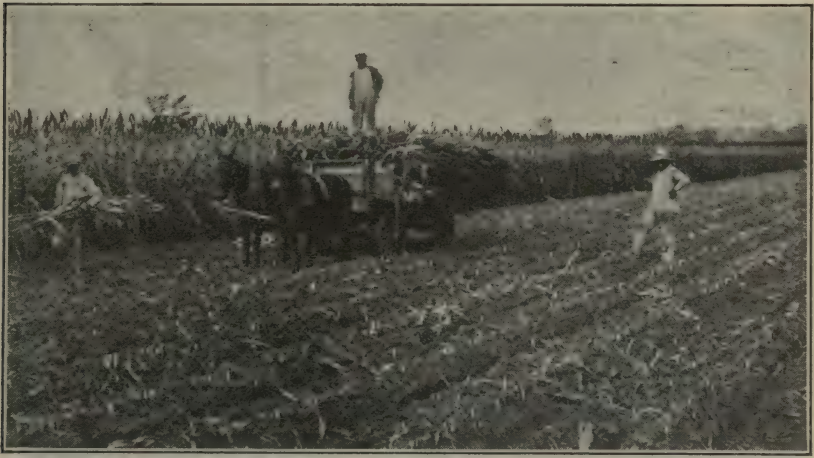

FIGURE 10.—Loading a wagon with sorgo stalks. The variety is Red X

Commercial companies sometimes make use of the railroads as a means of transporting harvested stalks from distant farms to the factory. Derricks are then often used to unload the wagons at the railroad stations and the railroad cars at the factory. (Fig. 11.) To facilitate unloading with derricks each wagon is equipped with a rope sling, which is placed in the bottom of the wagon and the stalks loaded upon it, the sling remaining around the wagonload of stalks until unloaded at the factory.

CARE OF THE SEED

As a general rule, more seed is produced than the grower needs for his own planting, although this is not always the case. Dry weather coming in the latter part of the growing season sometimes entirely prevents the production of seed, early frosts ruin heads that have not reached approximate maturity before severe frosts occur, and the sorghum midge (p. 38) often seriously reduces the seed crop in the Southern States. Seed saved for planting should be given special care to insure its purity and high viability. Only well-matured heads selected from the field before harvest should be retained, and these should be carefully cured, so that not only the seed but also the peduncles, axes, and branches of the heads become dry. This may be done (1) by spreading the heads upon a floor that is not roofed over, or upon a level or nearly level roof of a building; (2) by tying them in bunches and hanging in a dry, airy place, preferably under shelter; (3) by putting them loosely in gunny sacks and hanging these in a sunny, airy place; or (4) by subjecting them to artificial heat in a drier.

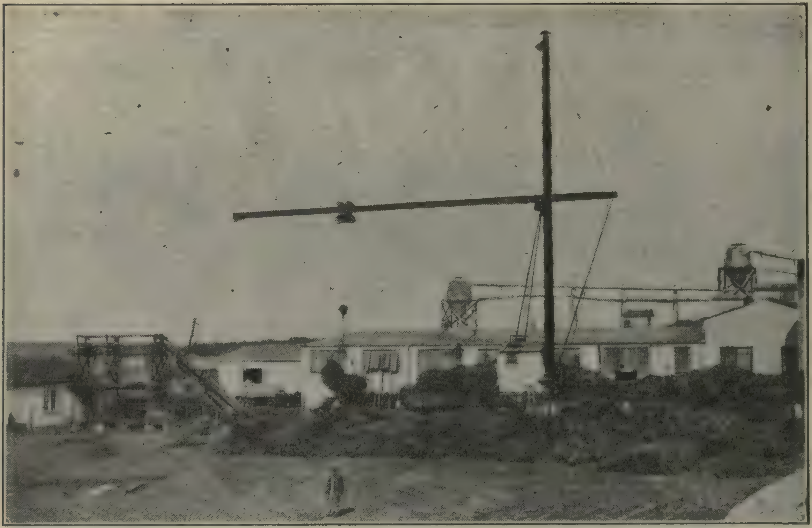

FIGURE 11.—Unloading sorgo from railroad cars by means of a power-operated derrick

Seed not selected in the field will vary considerably in quality, owing partly to the fact that ordinarily the crop is harvested before all the heads are completely ripe. Much of it may be used for planting. The better heads may be selected, threshed separately, and used or sold for planting, being especially adaptable for forage purposes. Sometimes much of the seed is only in the hard-dough stage when the crop is harvested. Such seed requires greater care in handling to prevent loss of vitality and is more difficult to cure. When well cured it will often show a good percentage of viability in germination tests.

In the warmer sections of the United States it is better to thresh the seed in the fall, so that it can be protected from grain weevils and grain moths during the winter. An ordinary grain thresher may be used when seed is produced in large quantities, but usually it is necessary to make adjustments in order to prevent breaking the seed. The speed of the cylinder may be reduced, and it is often advisable to remove some of the concave teeth. Seed saved for planting may be beaten out with a flail or with an ordinary stick, or raked out by drawing the heads across a row of spikes projecting close together from a plank or board; and the chaff may be removed by passing the seed through a fanning mill, by fanning it by hand, or by letting it fall on a sheet while the wind is blowing. Factories sometimes have small threshing machines especially made for threshing seed for planting. Where seed is produced in considerable quantities such a threshing machine and a fanning mill are serviceable.

After threshing, the seed should be thoroughly cured by aeration. This may be done by spreading it on a cement floor under shelter and turning it occasionally. Artificial driers are also sometimes used. It should then be put into containers. Carbon disulphide at the rate of about 4 to 6 pounds for each 1,000 cubic feet of space should be put into a small open vessel near the top of each container for fumigation purposes. It should be inclosed tightly. Carbon disulphide is a volatile liquid. The gas evolved, being heavier than air, will settle to the bottom, destroying weevils or grain moths present or that hatch out from eggs on the seed.

YIELDS OBTAINABLE

Crop yields vary greatly, not only on account of differences in fertility of fields and differences in the character of seasons, but also with the variety. For this reason it is impossible to state with accuracy what weights of stalks and of seed and yields of sirup may be expected. In general, the yields of stalks correspond with the length of the growing period, although there are a few early-maturing varieties that give yields as good as or better than some of the midseason varieties. For early varieties under average conditions 8 to 10 short tons per acre—total weight of stalks, heads, and leaves—may be considered a good yield; for medium varieties 10 to 12 tons; and for late varieties 12 to 16 tons. For one of the early-maturing varieties an acre yield of 23 tons has been reported, and 32 tons for one of the late-maturing varieties.

The proportions of heads and leaves vary greatly with the variety, with the stage of development, and with climatic conditions. The heads make up from 10 to 30 per cent and the leaves from 15 to 35 per cent of the weight of freshly harvested plants. Except where the leaves have been withered by frosts, the leaves and heads together probably constitute an average of 25 to 35 per cent of the total weight of uncured plants when in the proper stage for harvesting. The weight of the leaves and the ratio of the weight of the leaves to the total weight of the plant decrease rapidly after frosts, as well as in dry periods of weather. After cutting, the entire plant loses weight, the loss from the leaves being more rapid than from either the stalks or the heads.

Well-filled heads should thresh out 40 to 70 per cent of seed. Fifty per cent is a good average for a large number of varieties, though this will be exceeded by well-selected heads of certain varieties. The seeds will often lose some weight after threshing, but if the heads are well cured before threshing the loss will not be great.

Stalks after having had the leaves and heads removed should yield 40 to 60 per cent of juice, by weight, when passed through a 3-roller mill. Some sirup makers believe that in order to obtain sirup of highest quality the stalks should not be pressed hard enough to produce a high extraction of juice. It is thought that smaller quantities of impurities are then pressed out. This belief has not been definitely verified experimentally, and the large mills used by commercial factories, consisting of three units of three rollers each, sometimes give an extraction as great as 65 or 75 per cent of juice, as compared to the weight of stripped stalks. If the extracted juice has a density of 10° Baumé at a temperature of 63½° F., it indicates as shown by Table 5, that 82.3 per cent of the juice is water and that 17.7 per cent is solid matter, the latter being mainly sugars. From this it may be computed by the use of a table[8] that it would require 5.3 gallons of this juice to make a gallon of sirup having a density of 40° Baumé, providing no losses of soluble solids in the skimming or other defecating or purifying process occurred. Assuming an acre yield of 12 tons of stripped stalks and a 75 per cent extraction of juice having a density of 10°, it may be determined that approximately 375 gallons of sirup, having a density of 40°, would be obtained. Acre yields and the percentage of loss in the skimmings and elsewhere in the process of manufacture vary greatly, and figures obtained by the United States Department of Agriculture indicate that the average acre yield in the United States in 1928 was but 77.5 gallons of sirup.

The average yield of sirup per ton of sorgo stalks in the United States increased from 8.9 gallons in 1899 to 13.1 gallons in 1919, according to census estimates, but with proper methods of harvesting, handling, and manufacture a grower should obtain at least 16 gallons of sirup having a density of 38° or 40° Baumé from each ton of stripped stalks of the better varieties, better results than these often being obtained.

UTILIZATION OF SORGO SIRUP AND THE BY-PRODUCTS OF MANUFACTURE

Sirups made from sorgo juice have a value for table and culinary purposes not possessed by some other sirups. Brown bread, cookies, pies, and baked beans are articles of food in the preparation of which sorgo sirup is used, certain kinds of confections also being made from it. Sirup made on farms is sometimes purchased by buyers for commercial concerns, which put it on the market either in its pure state or as a mixed product; but more commonly the farm-made sirup is utilized in the locality where made. Sirup made by factories is sold either pure or mixed with other sirups. Sorgo sirup adds flavor and color to the mixed product, and the mixture is generally lighter in color than the sorgo sirup used as an ingredient.

The by-products of the crop are the seed, leaves, bagasse, head straw, and skimmings. Sometimes also there are waste stalks, which are readily eaten by livestock of all kinds. Commercial factories sometimes have small quantities of second-grade sirup. These by-products have a value and may be used or sold.

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[8] SPENCER, G. L. A HANDBOOK FOR CANE-SUGAR MANUFACTURERS AND THEIR CHEMISTS. Ed. 7, 560 p., illus. New York and London. 1929. (See pp. 471–475.)

Seed of any of the superior varieties not needed for the grower's own use, if pure, true to name, and of high viability, should find a ready market and bring a good price for planting purposes. In addition to its use for planting, the seed has a value as feed for poultry and other livestock. It is sometimes ground and used as an ingredient of mixed stock feed. Until recently it has been considered inferior to corn as a stock feed and somewhat less palatable, due to tannin contained; but recent experiments indicate that if ground and fed in a liberal grain ration, together with a liberal ration of alfalfa hay and silage, it is equal to corn chop in maintaining body weight or milk production of dairy cows and equal or superior to corn chop for the production of butterfat. It also appears as a result of these experiments that there is no difference as to the palatability of ground sorgo seed and corn chop when fed in the manner here described.

The leaves, if well taken care of, have a high value as roughage. They may be fed fresh or cured and stored, as preferred. After being cured they may be baled and sold. They are also sometimes ground into meal. In some cases the fresh leaves are put into silos either separately or in conjunction with the crushed stalks. The silage obtained is usually of good quality and its composition makes it valuable as roughage.

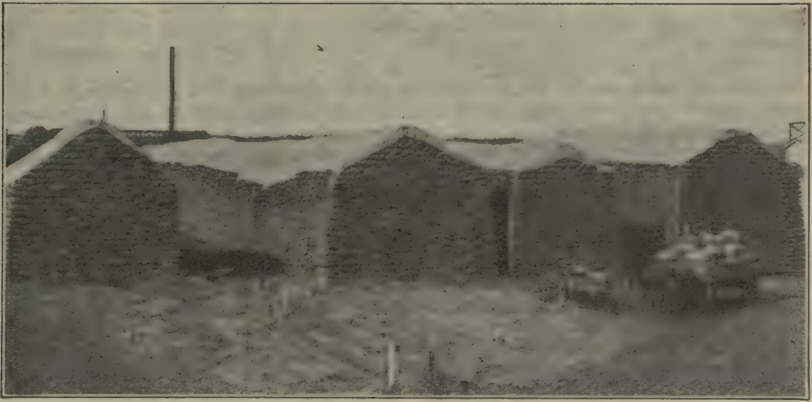

FIGURE 12.—Ground sorgo bagasse in bags ready for shipment

The remains of stalks after they have passed through a mill are called bagasse—sometimes incorrectly called pomace. (Fig. 12.) Bagasse may be used for fuel, commercial factories often having furnaces especially equipped for burning it. Other uses are the making of a building material called wall board, as a filler for prepared stock feed, and as bedding for cattle.

The straw and chaff that remain after threshing the heads, especially in cool weather, will to a large extent be eaten by livestock if they are allowed access to the stack.

Skimmings may be fed to hogs or to cattle. Frequently the skimmings are rich in sugars, and their feeding value is high. Low-grade sirup not suitable for table or culinary uses has value as feed, on account of the sugars contained. It is sometimes used in the preparation of mixed stock feeds. Both skimmings and waste sirup are also occasionally used for making vinegar.

SORGO DISEASES

Sorgo grown for sirup production is attacked by certain fungous and bacterial diseases, as well as by certain insect pests; but from reports of the United States Plant Disease Survey, covering the entire area of sorgo production, it does not seem that as yet diseases play a very important rôle in limiting production. The seed crop, however, is sometimes damaged considerably by smut. In commercial production, sorgo diseases are largely disregarded, special control measures not having become a part of general crop practices; but since some of the diseases may at some time become more seriously destructive, it is well for growers to become familiar with them.

STRIPE

The most conspicuous disease of sorgo is a bacterial disease called stripe.[9] This occurs on various sorgo varieties as well as on related grasses. In this disease extensive streaks or blotches occur on the leaf blades and leaf sheaths. The color of these streaks or blotches varies with the variety, ranging from amber color to a deep purplish or orange red.

At present, evidence is not at hand to show that this disease seriously affects yields, and as experimental work has given some evidence of differences in resistance among varieties, should it at any time become serious in particular localities, progress in control could doubtless quickly be made by the utilization of resistant types.

LEAF-SPOTTING DISEASES

Diseases of the leaf-spot type, called anthracnose[10] and leaf spot,[11] each year cause some losses, by reason of their effects upon the leaves. This varies with the season. Losses range from 1 to 5 per cent in wet seasons in some areas. No specific control measures have been tested for diseases of this type, and growers must rely upon the general practices of good crop growing. This is also true of leaf rust,[12] which is of general occurrence in the southern districts and occasionally causes some losses. It is not possible to make any specific recommendations for this disease.

SORGHUM SMUTS

The sorghum group of plants is attacked by three smuts, head smut,[13] loose kernel smut,[14] and covered kernel smut.[15] Head smut, as its name implies, involves the entire panicle or head, this being converted into a spore mass protected by a transient, whitish membrane. In general appearance this disease resembles the well-known smut of corn. It is not very abundant and, so far as sirup sorgos are concerned, is not of great importance.

The loose kernel smut of sorgo stunts the affected plants, and instead of sound kernels of seed numerous smut balls are produced in the head. These have very fragile inclosing membranes which soon break, and the head thus is converted into a black, smutty mass. This disease apparently does not cause appreciable damage in the United States.

Covered kernel smut is the most destructive of the smut diseases attacking sorgo. It is a typical kernel smut, the individual flowers being involved and converted into false kernels or smut balls, inclosed in a membrane, which is fairly tough and may persist until ruptured by threshing. The smut powder from the smut balls may be carried by the wind and some of it light on the sound kernels. In this way material for infection of the succeeding crop is furnished, the infection of the young seedlings taking place soon after the seeds germinate. The disease, for this reason, is amenable to control by some form of seed disinfection. Formaldehyde seed treatment has been recommended as a result of experiments. The seed should be soaked, preferably for about one hour, in a solution consisting of 1 pint of commercial formaldehyde in 30 gallons of water. It should be planted soon after receiving this treatment. Recent experiments have shown that the copper-carbonate seed treatment used to control stinking smut of wheat or treatment with sulphur dust will control covered smut of sorghum. About 2 ounces of either high-grade finely ground copper carbonate or flowers of sulphur are thoroughly mixed with the seed before planting. Copper carbonate is a poison, and care must be taken in its use. Should this smut disease become serious, one of these treatments should be used to control it.

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[9] *Bacterium andropogoni* EFS.

[10] *Colletotrichum lineola* Corda.

[11] *Cercospora sorghi* E. and E.

[12] *Puccinia purpurea* Cooke.

[13] *Sorosporium reilianum* (Kühn) McAlpine.

[14] *Sphacelotheca cruenta* (Kühn) Potter.

[15] *Sphacelotheca sorghi* (Link) Clinton.

It is not known that any of the smut diseases seriously injure the sorgo stalks for sirup making, except that they often retard growth, resulting in stunted plants and consequently reduced yields. The principal damage is the loss of the seed. The injury is therefore of less importance than it would be if the seed were of primary commercial importance.

There is some evidence to show that sorgo may be attacked by the same types of root-rot fungi that have proved so injurious to corn. So long as crop rotation is adhered to, growers are safeguarding against intensification of many types of disease. Because of this, crop rotation is very important from the viewpoint of disease control. Coupled with this, considerable gain will accrue from the utilization of varieties that are disease resistant. Care in the selection of suitable varieties means greater emphasis upon seed stock quality, which will result in greater care in seed selection and the avoidance of seed-borne diseases.

INSECTS INJURIOUS TO SORGO [16]

The sorghums as a rule are not severely damaged by insects, although a number of the general grass feeders may occasionally become so abundant as to be very destructive. Among these the chinch bug, cutworms, grasshoppers, the corn earworm, and others have long been familiar pests, and in most cases control measures are generally known. The following brief descriptions include several species of insects that may be considered of especial interest in sorgo production.

THE SUGARCANE MOTH BORER [17]

In the production of sorghum in the southern parts of Texas, Louisiana, Mississippi, and Florida the sugarcane moth borer is likely to be encountered. This is a "worm" about an inch in length when full grown and will be found in tunnels in the stalks. The adult of the borer is a straw-colored moth which deposits its eggs on the leaves of the plants. The small larvae which emerge first feed a little on the leaves, and then make their way into the interior of the stalks, where they pass the rest of the larval stage and all of the pupal stage. The resulting moth makes its way out of the stalk through a hole partly cut for it by the larva before pupating.

The damage to the stalk often results in the dying of the upper leaves and the whitening of the seed cluster. A heavy infestation would result in a decrease in the quantity and the quality of the sirup manufactured. Fortunately, however, sorghum is not a favorite host plant of the sugarcane moth borer. In the infested districts sorghums should be planted as far as possible from fields of sugarcane and corn, and care should be taken to destroy at some time during the winter all larvae hibernating in stubble and pieces of the stalks.

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[16] Prepared in the Bureau of Entomology.

[17] *Diatraea saccharalis crambidoides* Grote.

THE SORGHUM MIDGE [18]

The sorghum midge occurs in the South-Central States. It is a very small 2-winged fly which deposits its eggs in the glumes at blossoming time. The maggots which emerge feed on the developing seeds, thus destroying them. It has been found that Johnson grass affords the midge a suitable food plant on which to pass the winter, and the recommendation has therefore been made to destroy grasses in the vicinity of fields that are to be planted to sorghum. For the production of a limited quantity of seed, the seed clusters can be bagged to prevent midge infestation. The fumigation of the gathered seed and the cleaning of the fields of bits of sorghum and grass during the winter have been recommended.

THE CORN-LEAF APHIS [19]

This green aphis, common on corn, also occurs on sorghum. It is found on the leaves, from which it sucks the juice. Its principal injury is due to the fact that it is a carrier of the sugarcane mosaic disease, which occurs in the sugarcane-growing sections of the South; this disease also attacks sorgo. It is desirable, therefore, to plant sorghum in these sections at some distance from fields of corn, sugarcane, and infested grasses.

THE FALL ARMY WORM [20]

The fall army worm is a striped caterpillar, practically hairless and about 1½ inches in length when full grown. It appears during a wet spring along the Gulf coast, and shows up in the fall in the North. It feeds on the leaves of corn, sugarcane, and sorghum, hiding in the throat of the plant. In the extreme South it does some damage but then largely disappears, doubtless being controlled by parasites. Arsenicals may be used against it if necessary.

INSECTS INJURIOUS TO THE STORED SEED

The seeds of sorghums are attacked by many of the insects that commonly infest stored grains. The more important of these are the rice weevil [21] and the Angoumois grain moth.[22] These two insects attack the seed in the field and continue their depredations after the seed is placed in storage. All of these seed-infesting insects can be controlled by a thorough fumigation with carbon disulphide. (See p. 33.)

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[18] *Contarinia sorghicola* Coq.
[19] *Aphis maidis* Fitch.
[20] *Laphygma frugiperda* S. and A.
[21] *Sitophilus oryzae* L.
[22] *Sitotroga cerealella* Oliv.

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GROWING CUCUMBERS FOR PICKLING

By J. H. Beattie, *Associate Horticulturist, Office of Horticultural Crops and Diseases, Bureau of Plant Industry*

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INTRODUCTION

AT LEAST 4,000,000 bushels of cucumbers are used for pickling in the United States each year. On the basis of first-grade sizes this would mean almost 3,000,000,000 pickles, a number large enough to prove the fondness of the public for a product low in food value but exceedingly popular as an appetizer and relish with other foods. In certain sections the production of cucumbers for pickling is an important industry bringing good returns to the growers. It is a cash crop that usually makes an appreciable addition to the farm income. Boys and girls often find a patch of cucumbers a most satisfactory means of making extra money for school or other purposes. This publication has as its purpose the description of cultural practices that are most successful in giving maximum yields.

DISTRIBUTION OF COMMERCIAL CUCUMBER GROWING FOR PICKLING

The industry of growing cucumbers for pickling is distributed over a wide portion of the United States, especially the north-central area. Data collected and compiled by the Bureau of Agricultural Economics, United States Department of Agriculture, as to the acreage and value of cucumbers for pickling in the years 1925 to 1928, inclusive, are shown in Table 1. The average acreage for these years was 74,000. Michigan and Wisconsin usually produce about one-half of the pickling cucumber crop of the United States, but Indiana, Minnesota, Colorado, California, and other States also grow large quantities.

TABLE 1.—*Distribution, acreage, and value of cucumbers grown for pickling in the years 1925 to 1928, inclusive*

State	Acreage				Value			
	1925	1926	1927	1928	1925	1926	1927	1928
California	3, 210	2, 560	2, 120	2, 760	$535, 000	$343, 000	$327, 000	$301. 000
Colorado	3, 500	2, 900	3, 130	2, 300	357, 000	154, 000	117, 000	145. 000
Illinois	1, 630	940	870	1, 560	158, 000	57, 000	37, 000	104, 000
Indiana	8, 430	7, 250	7, 470	9, 870	477, 000	439, 000	264, 000	549, 000
Iowa	2, 850	800	340	470	193, 000	38, 000	14, 000	32, 000
Michigan	36, 810	25, 030	20, 360	22, 840	2, 248, 000	1, 030, 000	550, 000	1, 156. 000
Minnesota	4, 340	3, 000	1, 770	3, 210	201, 000	122, 000	39, 000	85, 000
Missouri	1, 050	2, 800	670	1, 050	56, 000	80, 000	35, 000	57, 000
New York	1, 320	920	680	800	152, 000	28, 000	44, 000	39, 000
Ohio	2, 250	1, 600	1, 790	2, 200	204, 000	79, 000	64, 000	143, 000
Washington	670	530	430	460	97, 000	29, 000	24, 000	39, 000
Wisconsin	20, 960	11, 950	8, 500	10, 190	1, 252, 000	550, 000	367, 000	456, 000
Other States	13, 110	10, 360	9, 930	9, 570	1, 043, 000	566, 000	648, 000	386, 000
Total	100, 130	70, 640	58, 060	67, 280	6, 973, 000	3, 515, 000	2, 530, 000	3, 492, 000

FACTORS AFFECTING THE INDUSTRY

The cucumber-pickling industry has attained its greatest importance in sections having a combination of climatic and soil conditions especially suitable for the crop. Desirable conditions are a fertile soil, a relatively long growing season of 120 to 150 days without extremes of heat or cold, and a moderate supply of moisture in the form of rainfall or by irrigation.

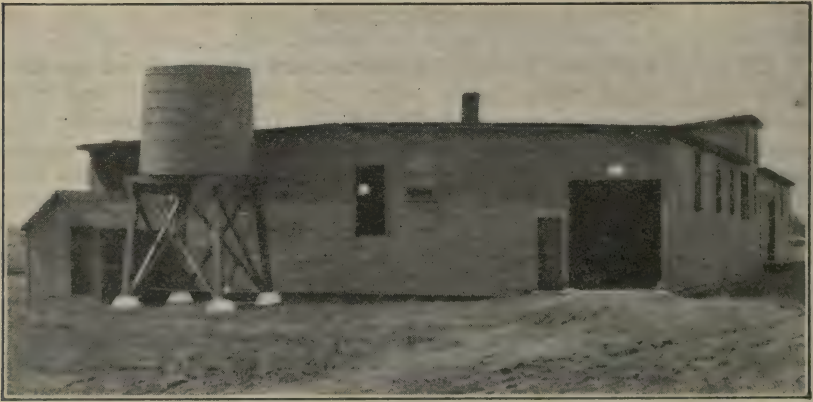

FIGURE 1.—Salting station for receiving and storing cucumber pickling stock

The handling of the crop requires that salting stations be available within a reasonable distance of the growers. These stations are almost invariably operated by pickle companies. A salting station is not especially expensive, usually consisting of a 1-story building (fig. 1) equipped with scales, screens, tanks, pumps, and other equipment needed for handling, salting, and storing the material. In localities where acreage can be contracted for, such stations can be provided without special difficulty. In some places brining tanks are mounted on flat cars, which are set on a siding while the cucumbers are being received, and are afterwards moved to the factory;

in others, small stations (fig. 2) are provided for receiving the cucumbers, and the material is then hauled by truck to salting stations or to the factory.

Although the commercial production of cucumbers for pickling is usually for this specific purpose, some attention has been given to the possibilities of the utilization of surplus market-crop cucumbers for pickling, especially in southern locations, where large quantities are grown for the early market. Some additional income often may be obtained by following this practice, but the bulk of the supply of cucumbers for pickles is grown entirely for that purpose. Summer temperatures in the lower South, and more especially the prevalence there of insect and disease enemies unfavorable to cucumbers during midsummer, have the effect of centralizing the cucumber-pickling industry in northerly locations at present.

The planting and the cultural care of the crop are not particularly difficult, but few growers undertake more than an acre or two each season, because harvesting requires much handwork which must be performed frequently, sometimes daily, when growing conditions are favorable. Wide spacing of the plants is now generally practiced, as this greatly facilitates harvesting.

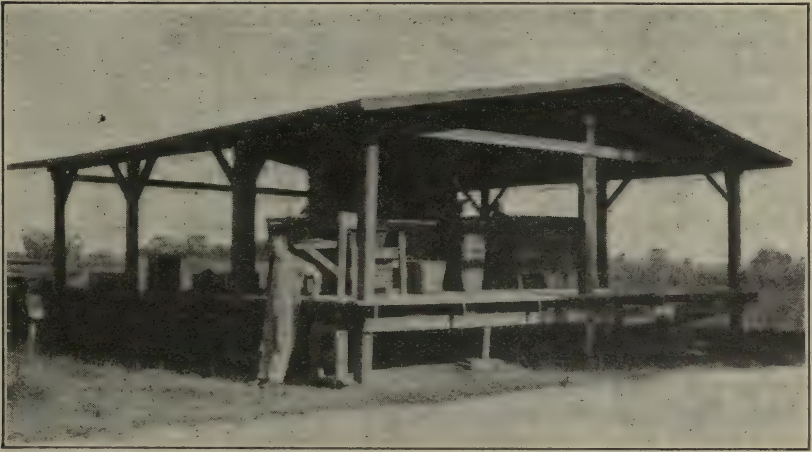

FIGURE 2.—Collecting station for cucumber pickling stock

TYPE OF LAND NEEDED

None but the best land can be depended upon to give maximum yields of well-formed pickling cucumbers. The majority of growers believe that sandy loam, and even clay loam well supplied with organic matter and in good physical condition, are best adapted to the crop; nevertheless, cucumbers are successfully grown on many other types of soil, including peat, muck, clay, and even somewhat light sands. Soils of the lighter character, however, are especially likely to be affected by drought and are therefore undesirable. A soil with a rolling topography with good air drainage is preferable, because lowlands including muck and peat may be subject to frost damage.

Cucumbers should not be planted on land that has been recently used for melons, pumpkins, squashes, or cucumbers. It is recommended that cucumbers do not follow potatoes, sugar beets, cabbage, or other crops that make heavy demands on the fertility of the soil. A clover or alfalfa sod is recommended by growers as the best type of land for cucumber culture.

LAND PREPARATION

Preparation of the land for growing cucumbers for pickling is carried on in the same way as preparation for other farm crops. Thoroughness in all operations is of prime importance. Fall plowing may be desirable, especially on heavy land which will not wash or blow; moreover, lands of heavy texture plowed in the fall are mellowed by freezing and thawing. Plowing should be done either by tractor or by a heavy team plow capable of turning the entire furrow slice to depths of 6 to 8 inches, or even deeper if the character of the land makes this advisable. In cases where it is desirable to plow manure under, or to work lime into the soil, during the preliminary preparation of the land, it is frequently necessary to modify the preparation methods. A fine, compact seed bed, entirely free from stones, roots, or other obstructions, is desirable for cucumbers.

MANURE, FERTILIZER, AND LIME

Land well supplied with organic matter free from injurious diseases is desirable for cucumbers. However, an application of well-rotted manure is nearly always advantageous, and where available at moderate cost it continues to be the main dependence of many growers as a source of organic matter and plant food. Manure should be free from cucurbit remains, as these may carry diseases to the crop. Fortunately, nearly all farmers who grow cucumbers for pickling have sufficient manure to give their land a moderate dressing. Usually good results are obtained by broadcasting 8 to 10 tons to the acre about two weeks before planting time and thoroughly working it into the soil during preparation for the crop. Heavy applications are not advised, as a rule, provided the land has had good previous treatment.

Some successful growers supplement the manure application by a broadcast dressing of superphosphate, putting this on at the time the manure is applied. In most cases this practice is advisable.

Although many growers continue to depend entirely on manure, supplemental applications of high-grade fertilizer usually increase yields to a profitable extent. The specific fertilizer formula and the rate of application for each case must be determined by such factors as the natural fertility of the soil and its previous crop treatment. In general, a mixture containing 4 to 5 per cent nitrogen, 8 to 10 per cent phosphoric acid, and 5 to 6 per cent potash, used at rates of 500 to 1,000 pounds per acre, is satisfactory. With applications of 500 pounds or less per acre the fertilizer can be applied in the row and mixed with the soil before seeding. Quantities in excess of 500 pounds per acre should be applied broadcast and harrowed in before planting. With land having a heavy clover or alfalfa sod it is permissible to decrease the percentage of nitrogen, and in some cases the potash. On such land a 2–10–4 formula at the same rates of application is generally sufficient. Commercial fertilizer alone should not be depended upon to produce good yields on soil deficient in organic matter. It is to be regarded as a supplement to organic matter and not as a substitute for it. The more general use of commercial fertilizer on pickling-crop cucumbers, especially on soils high in organic matter, without doubt would greatly increase yields and profits to both grower and buyer.

The cucumber is sensitive to acid soil; therefore an application of lime should be made to land which shows the need for corrective measures. There are a number of simple soil tests for acidity. Information in regard to such tests may be obtained from the various State experiment stations or from the United States Department of Agriculture.

VARIETIES AND SEED

Cucumbers are sometimes grown for the double purpose of marketing as fresh cucumbers and for pickling. The early portion of the crop is marketed fresh, and the later portions are sold for pickling. For this double purpose varieties having especially desirable marketing qualities are employed, but these are not especially satisfactory for the making of pickles. Moreover, plants that have grown full-sized cucumbers do not, as a rule, yield a high-grade product for pickling. Conditions sometimes justify the making of pickles to utilize a surplus crop that can not be profitably marketed as fresh cucumbers, but the bulk of the supply of cucumber pickles comes from crops planted and grown for that specific purpose.

A pickling variety of cucumber should be of the black-spine type and should combine early maturity with heavy production over a long season. The fruits should be of medium size, cylindrical shape, uniform dark-green color, and reasonably free from spines. Snow's Pickling, Chicago Pickling, Boston Pickling, and Jersey Pickling are four of the best-known varieties. The crop is usually grown under contract, and the pickle manufacturers usually reserve the right to specify the variety to be grown.

Good seed is of prime importance. From 1 to 1¼ pounds of seed is required to plant 1 acre. Some of the pickle companies supply their growers with seed, either free or at a nominal price. Seedsmen, particularly those in pickle-producing regions, pay special attention to supplying seed for the crop. It is quite possible for the individual grower to save his seed, but unless he has special facilities for saving and caring for the seed it may be better to purchase from those who are equipped to give the matter the special attention it demands.

Soaking the seed for five minutes in a 1 to 1,000 corrosive sublimate solution, washing in clear water, and drying is a wise precaution that helps in the control of certain diseases, particularly angular leaf spot.

PLANTING

Planting distances vary, but it has been found that wide spacing is advantageous. Rows are usually spaced 6 to 7 feet apart, with the hills from 3 to 4 feet apart in the rows. Starr[1] makes the following comments on the subject:

> If the plants are grown in hills, the field may be marked out in rows 4 feet apart one way and 6 feet apart the other. Sufficient seed should be planted in each hill to insure a full stand. After the plants are well established they should be thinned to two to the hill. In planting by hand with a hoe, care should be taken to place the seeds in moist soil, which should be lightly tamped with the hoe, after which a little loose soil should be drawn over the hill. This will check evaporation and prevent the formation of a crust. Not more that 1 inch of soil should cover the seed.

Later the same author says:

> Many growers are now planting cucumbers in drills. If this method is practiced, it is necessary to mark the field one way only. The seeds are drilled in continuous rows, spaced 5 to 6 feet apart, and later the plants are thinned to stand 12 to 18 inches apart in the rows. This method tends to secure a more uniform distribution of the seed, involves less labor in planting, and facilitates harvesting operations. On the other hand, with the crop in hills it is possible to cultivate in both directions, thus saving somewhat in hand hoeing.

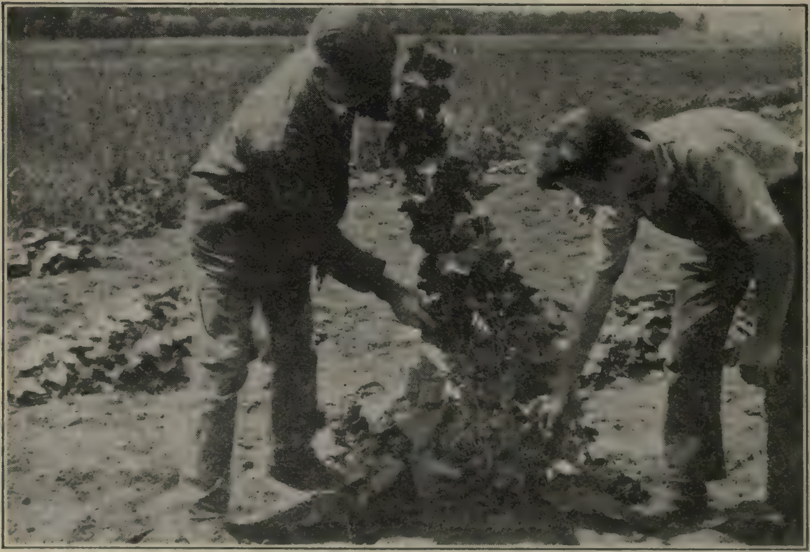

FIGURE 3.—Thin planting, with one plant in each hill, a method of planting which makes picking easier

Many growers now make a practice of thinning to one plant in a hill; this branches profusely, often forming as many as 20 branches. Yields compare favorably with those from plants more closely spaced, and it is much easier to cultivate, spray or dust, and harvest the crop with these wide spacings. Figures 3 and 4 show a field with one plant in a hill. These photographs were made at the beginning of harvest and show how wide spacing and thinning to one plant in a place facilitates harvesting.

Figure 5 shows a field where close spacing and thick planting have been practiced, making the work of harvesting very difficult.

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[1] STARR, G. E. CUCUMBER CULTURE. Mich. Agr. Expt. Sta. Circ. Bul. 90, 11 p. 1926.

Figure 6 shows conditions in a cucumber field where the plants are in drills. Cultivation can be carried on in but one direction, and the work of harvesting is increased. Wide spacing and thinning make it possible to find all the fruits while of prime size for pickling, thereby insuring the highest financial returns. If the cucumbers are removed while they are small and while the seeds are soft, the quantity of high-grade cucumbers for pickling will be materially increased.

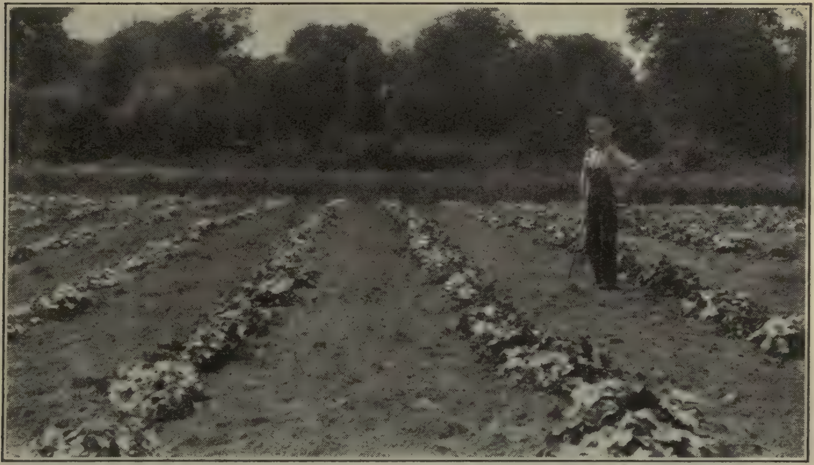

FIGURE 4.—Cucumbers thinly spaced in wide rows, a method of planting that facilitates cultural operations and picking

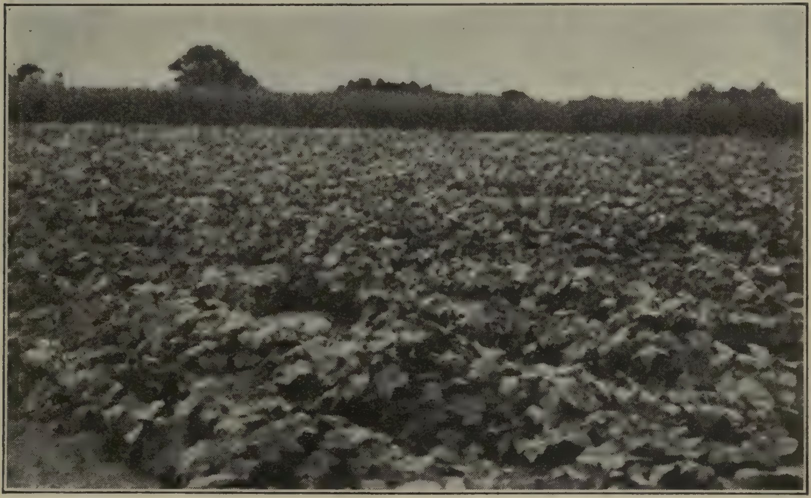

FIGURE 5.—Cucumbers planted thickly and in closely spaced rows. It is difficult to cultivate and harvest cucumbers planted in this way

In northern Indiana and southern Michigan, where the cucumber-pickling industry has attained its greatest importance, planting is done during May and early June. In any case it must be deferred until the ground is well warmed up and the likelihood of frost is past. Occasionally it happens that destructive frosts occur later in the season, but such cases are rare.

Soaking cucumber seed in water overnight will hasten sprouting. The soaked seed will come up in about three days, whereas unsoaked seed takes much longer, depending upon moisture, temperature, and other factors. Soaking is best accomplished by placing the seed in a muslin bag and immersing it in tepid water.

The first thinning should be made when the seedlings have from four to six leaves. Cutting the extra plants just above the soil surface, leaving the stronger and stockier ones, is recommended. When the plants have reached a length of 15 to 25 inches they should be reduced in number to the desired stand. Plants having plenty of room frequently have 15 to 25 strong lateral branches and often yield more cucumbers than are obtained from plants more closely spaced.

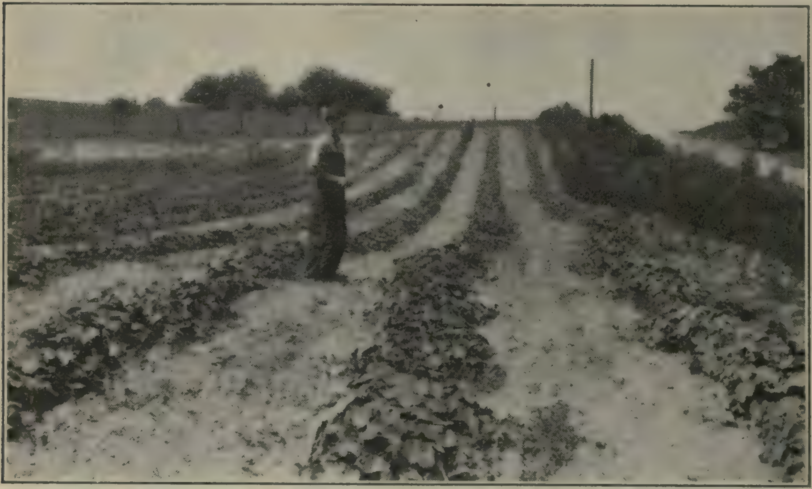

FIGURE 6.—Cucumbers closely spaced in drills, a method of planting that interferes with cultivation and harvesting

CULTIVATION

The most important part of the cultivation of the cucumber crop consists in the careful preparation of the land. If it is well plowed and thoroughly fined to a depth of several inches the only subsequent cultivation necessary is that needed to control weeds. Since the cucumber is a shallow-rooted plant, cultivation not more than 2 inches in depth is best, because deeper stirring of the soil will injure the roots and hinder the growth of the plant. A 1-horse spike-tooth cultivator, with the teeth sloping back, is excellent. Two-horse cultivators may also be employed, particularly during the early part of the season when the vines are small, but as a rule the plants attain sufficient size by midseason to make such culture impracticable. However, if the vines are turned, horse work may be continued much longer, insuring better weed control at lessened labor cost. Removal by hand of weeds and grass in the rows and close to the plants is necessary, but careful horse work will reduce the labor to a minimum. Cultivation or handling of the vines while wet should be avoided, as tillage tools, the hands, or clothing are likely to spread such diseases as mosaic, bacterial wilt, anthracnose, and cucumber scab from diseased to healthy plants.

TRIMMING VINES AND THINNING FRUITS

As a rule the vines of field cucumbers for pickling are not trimmed, since wide spacing gives each plant sufficient room to develop normally. Thinning of the fruits is never necessary. Harvesting small cucumbers from 2 to 3 inches in length has much the same effect as thinning the fruits, because it prevents them from reaching the stage where they would draw heavily on the energy of the plant.

PREVENTION OF DAMAGE FROM WIND AND COLD

The cucumber is especially sensitive to low temperatures. Damage from frost may be largely avoided by using land that has good natural air drainage and by deferring planting until two or three weeks after the average date of the last killing frost in the spring. In the commercial cucumber-pickle regions much attention is paid to the selection of land that is known as frost free. Lowlands that are fertile and otherwise suitable for cucumbers are usually avoided on account of their susceptibility to frost.

Cold winds are particularly injurious to cucumbers. Selection of a location protected by woodland or by artificial windbreaks will do much toward lessening all types of wind injury.

INSECT AND DISEASE CONTROL

INSECTS [2]

Cucumbers are attacked by a number of insects, two of which, the striped cucumber beetle and the melon aphid or louse, are widespread and are the cause of damage in most of the commercial producing territory.

THE STRIPED CUCUMBER BEETLE

The striped cucumber beetle appears in the late spring or early summer at about the time the earliest cucumber plants are coming through the ground. It may occur suddenly in large numbers, destroying the developing seedlings in a short time.

The control of the cucumber beetle is difficult, but there are several methods that have been used to advantage. In sections where climatic conditions are favorable, nicotine dust has given good results against this pest. A dust containing 3 per cent of nicotine is recommended, to be applied at a time when the foliage of the plant is dry and when the air temperature is above 70° F. This dust is prepared by mixing either a solution of free nicotine or nicotine sulphate with some carrier such as hydrated lime. The material can be obtained from commercial concerns, or it may be prepared by the grower. However, its preparation needs especial care, and unless the grower is properly equipped to make and store his own dust it is recommended that the commercial products be used, although they are more expensive than home-prepared mixtures. Instructions on the preparation of nicotine dust are given in Farmers' Bulletin 1499.[3]

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[2] Prepared by W. H. White, Entomologist, Truck-Crop Insect Investigations, Bureau of Entomology, U. S. Department of Agriculture.

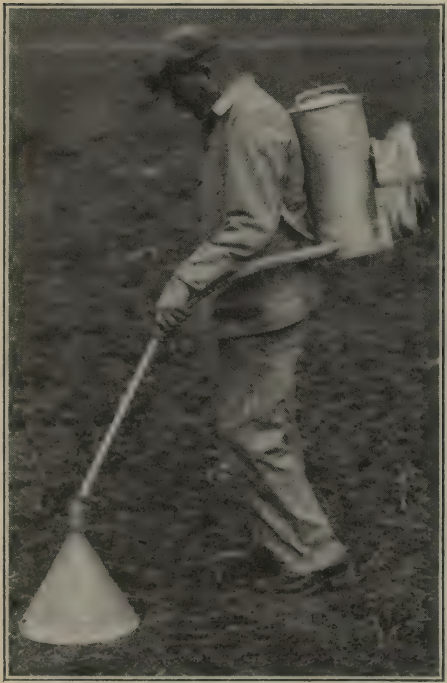

FIGURE 7.—Device for dusting cucumbers during early stages of growth

Nicotine dust kills by contact. Therefore, in the process of treatment it is necessary to cover the beetles with the dust. Special types of apparatus have been devised to prevent the escape of the beetles from the plants during treatments. One type of such apparatus consists of a funnel-shaped cone attached to the end of the discharge tube of the duster. An apparatus of this kind is shown in Figure 7. The box duster shown in Figure 8 is an inexpensive apparatus fairly well adapted for the application of nicotine dust. It is 8 to 10 inches square and about 12 inches deep, without top or bottom but with a suitable handle. Inside of this box and fastened to the upper edges is a porous bag of either cheesecloth or burlap from which the dust is sifted as the box is dropped over each hill or plant. The device is allowed to remain over each plant for a few seconds. The foregoing methods are adapted to the treating of plants in hills. When the seed is drilled in (fig. 6), the dust is best applied with the ordinary bellows or handle duster equipped with a type of nozzle that will direct the dust to all parts of the plant. Even in the case of large plantings, it will be found more economical to apply the dust by hand power, since in the use of power machines a large quantity of the material is wasted, especially if the crop is planted in hills.

In some sections good control of the striped cucumber beetle has been obtained by the use of a dust consisting of 1 part of calcium arsenate to 15 to 20 parts of gypsum or land plaster. In the use of this material it is necessary to keep the plants fairly well covered with the dust from the time that they appear aboveground until they have reached the runner stage, in order to protect the new growth. At this period in its growth the plant is usually able to withstand the attack of the beetle. Spraying with Bordeaux mixture and lead arsenate will also protect the plants.

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[3] CHITTENDEN, F. H., and WHITE, W. H. THE MELON APHID AND ITS CONTROL. U. S. Dept. Agr. Farmers' Bul. 1499, 17 p., illus. 1926.

The spotted cucumber beetle sometimes becomes a serious pest of the cucumber. It is more difficult of control than the striped cucumber beetle, but the measures recommended for the latter pest will give some relief.

THE MELON APHID

The melon aphid, commonly called the melon louse, feeds on the underside of the leaves, sucking the plant juices and causing the leaves to curl, lose color, and finally die. An especially serious phase of aphid injury is its part in transmitting mosaic and other diseases. Winged females start the infestation early in spring as small colonies which soon spread to adjoining plants. Early control measures are essential. Nicotine dust containing 2 to 3 per cent nicotine, applied to the underside of the leaves, gives effective control. In cases of mild infestation it is usually sufficient to dust affected and near-by plants, but if the pest is well distributed it may be advisable to dust the entire field. For dusting single plants a good hand duster with a nozzle that will shoot the dust upward so as to reach the underside of the leaves is satisfactory. For dusting the entire field a power machine may be used. Whatever device is employed, the dust must reach the underside of the leaves.

Spraying with nicotine sulphate is an effective control of the melon aphid. The solution is prepared by using three-eighths of a pint of 40 per cent nicotine sulphate, 2 to 4 pounds of laundry or preferably fish-oil soap, and 50 gallons of water. The object of the soap is to make the spray spread evenly, and the presence of globules on the leaves indicates the need for more soap. In using insecticides for the control of this insect it should be kept in mind that they must actually strike the insects. The application of spray to the tops of the leaves will not control or even seriously annoy this insect. Farmers' Bulletin 1499[4] gives further information.

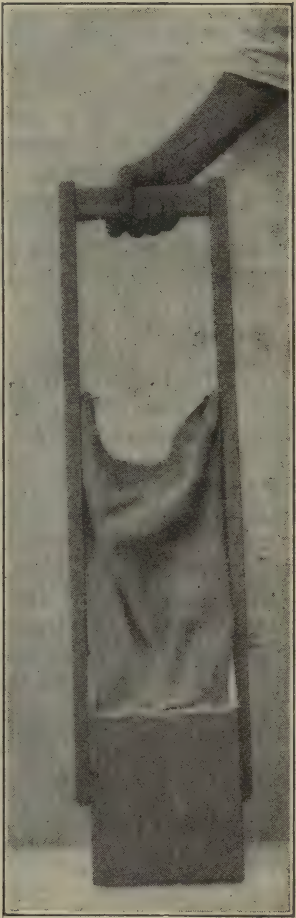

FIGURE 8.—Box duster for applying nicotine dust to cucumbers

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[4] See footnote 3.

DISEASES [5]

Cucumbers as a pickling crop are subject to a number of diseases, some of which may be avoided by planting on clean land and others reduced in severity by seed treatment, spraying, or other available control measures.

In the more northern sections, where the major portion of the pickling crop is grown, the most important diseases are bacterial wilt, mosaic, and anthracnose, with scab occurring in moist cool seasons. Angular leaf spot often causes considerable damage under favorable conditions.

In more southern locations downy mildew, root knot, and bacterial wilt are generally most common and severe.

Some of the diseases of cucumbers, muskmelons, and watermelons are caused by the same organisms, and for this reason cucumbers should not be planted in or adjacent to land where any of these crops were grown the previous year. A 2-year or 3-year rotation is even better to guard against a disease living over winter in the soil.

BACTERIAL WILT

The bacterial wilt disease of cucumbers may reasonably be suspected when plants suddenly wilt and die without visible reason. This disease may attack seedlings a few inches tall as well as plants in midseason. It is caused by bacteria which enter and clog the water vessels of the stems and roots. Death of the plants generally follows soon. The causal bacteria do not live in the soil, but are carried over winter and spread in the field by insects, especially the striped cucumber beetle and the 12-spotted cucumber beetle.

The best method for the prevention of loss from this disease is closely related to the control of the beetles, which are primarily responsible for its spread. Spraying with 4-4-50 Bordeaux mixture and lead arsenate, or dusting with 1 part of calcium arsenate to 15 to 20 parts of gypsum, combined with the pulling and burying or burning of wilted plants early in the season, constitute the best control measures known. Nicotine dust has also been used with good results. Treatments should be begun as soon as the plants appear above the ground and should be repeated as often as necessary to keep the new growth protected.

MOSAIC

The disease commonly called mosaic or "white pickle" belongs to the type of virus diseases. Its causal organism, if it has one, has not been found, but it is known to be carried in the sap of diseased plants and may be spread by insects, pickers, and field implements.

Mosaic occurs in many localities throughout the country and has frequently caused heavy losses to cucumber growers, especially in Michigan and Wisconsin. It is characterized by dwarfing of the plants, mottling, yellowing, and wrinkling of the leaves, and warting, curling, and mottling of the fruits. The disease does not live over winter in the soil, nor does seed from mosaic cucumber plants often carry the disease. Its chief places of overwintering are in the seed of the wild cucumber, commonly grown as an ornamental vine, and in the roots of other host plants such as pokeweed, milkweed, groundcherry, and catnip. From these wild host plants, which come up ahead of cultivated crops, it is carried in the spring to cucumber fields by the striped cucumber beetle, aphids, or other insects.

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[5] Prepared by W. W. Gilbert, Senior Pathologist, Office of Horticultural Crops and Diseases, Bureau of Plant Industry.

The thorough eradication of the wild host plants in and near the fields, combined with the rigid control of insects, has in many cases proved very successful in controlling mosaic.

SCAB

The fungous disease known as scab is often very serious during moist cool seasons in certain northern cucumber-growing sections, especially in Michigan, Wisconsin, Minnesota, and Maine. On the leaves, stems, and fruits small water-soaked spots are produced, on which drops of a milky material are found early in the morning. The damage is most serious on the younger fruits in the form of small, sunken, rounded, or irregular cavities which frequently cause curling of the fruits. The disease spreads very rapidly in the field under cool moist conditions, and because of the great difficulty of sorting out diseased stock, deliveries are often refused from fields where the trouble has become well established.

Since the causal fungus lives over winter in the soil of fields where the disease has occurred, cucumbers should be planted on land not in that crop for one or more years. It is advisable to plant in locations with good air drainage and to avoid thick planting.

ROOT KNOT

Root knot is caused by tiny eelworms, or nematodes, which attack the roots of cucumbers and many other farm crops and produce galls or swellings. Affected plants are stunted or killed, and the yields are often much reduced. This trouble is frequently very serious in the sandy soils of the South, but is rarely of importance on pickling cucumbers in the North. Crop rotation and planting cucumbers only on land free from nematodes are the best methods now known of avoiding losses from root knot.

ANGULAR LEAF SPOT

Angular leaf spot, anthracnose, and downy mildew all cause their principal visible injury to the leaves, developing and spreading rapidly during moist warm weather.

Angular leaf spot, a bacterial disease, is characterized by small angular water-soaked spots on the leaves. In the later stages the spots dry out, become light tan to white in color, and sometimes drop out following heavy rains, giving the leaves a ragged appearance and causing considerable injury to the plant, especially when the attack comes early in the season. On the fruits very small round spots are sometimes seen which at first are water-soaked but later become whitish. The causal organism lives over winter in the soil and on the seed. Seed treatment for five minutes in a 1 to 1,000 mercuric-chloride solution followed by thorough washing in running water is an effective remedy when combined with crop rotation to avoid infection from the soil. Thorough spraying with 4–4–50 Bordeaux mixture will also help to control the disease.

ANTHRACNOSE

Anthracnose, caused by a fungus, produces light-brown roundish spots, one-fourth to one-half inch in diameter, on the leaves, and elongated whitish sunken areas on the stems. The fruits in the crop as grown for pickling purposes are not commonly attacked by the fungus, but the loss to the crop comes from the reduction of the yield through premature killing of the vines. If hot, dry weather occurs, the disease may make little progress even though infection is present. The causal fungus is carried over winter on the seed and in the dead vines from a diseased crop. The best method of control is the same as that for angular leaf spot, viz, seed treatment, crop rotation, and spraying with Bordeaux mixture.

DOWNY MILDEW

Downy mildew, also caused by a fungus, is recognized by a faint yellow angular spotting of the leaves, which soon curl, dry up, and die. The fruits are not directly affected, but the yield is so reduced by the killing of the affected plants that losses are often considerable under favorable weather conditions. Mildew is most common and severe along the Atlantic seaboard and in the Gulf States. In the Central States its occurrence is less certain, it comes later in the season, and it causes less damage. Thorough spraying of the cucumber vines with 4–4–50 Bordeaux mixture is the best available method of control for mildew and will materially check its development if begun when the first signs of disease appear and repeated at intervals of 7 to 10 days to keep the new growth protected.

SPRAYING AND DUSTING TO CONTROL LEAF DISEASES

Spraying with Bordeaux mixture is a preventive rather than a cure for fungous and bacterial leaf diseases. For the most successful results the work must be started early in the season (before the diseases become established) and must be done thoroughly with high pressure, so that all parts of the plants are kept coated with the spray mixture. It is also important that the Bordeaux mixture be properly made and applied at intervals sufficiently frequent to cover the new growth promptly.

For most cases the 4–4–50 Bordeaux mixture (4 pounds copper sulphate, 4 pounds stone lime, to 50 gallons of water) is recommended, but sometimes a weaker solution (2–4–50) is advised, especially in sections where vine injury has resulted from the stronger mixture.

The spraying of pickling cucumbers has in many sections come to be looked on as a second line of defense in fighting leaf diseases, to be used only in case the seed treatment and crop-rotation methods have not been successful in preventing or sufficiently delaying the outbreak of disease.

Dusting with copper-lime fungicidal dusts has been tested to a considerable extent; in some instances the results were equal or nearly equal to those obtained with spraying. Its principal advantage is its quicker and easier application and the fact that the handling of large quantities of water is eliminated. Its main drawbacks are the greater cost of material and, in some instances, reduced effectiveness in disease control. Each grower must determine for his particular conditions whether spraying or dusting will be most advantageous and economical when such means of disease control is needed.

HARVESTING AND HANDLING

The rate of growth of the cucumber depends upon soil fertility, temperature, moisture supply, and the degree of protection afforded from injury by insects and diseases. Under favorable conditions cucumbers should begin blooming in a month to six weeks from the time the seed is planted and should produce fruit of pickling size in about eight weeks from seeding. At first the blooms are nearly all male or staminate, but later on the female or pistillate flowers appear in abundance. These are easily distinguished by the small cucumber between the flower and the stem. Figure 9 shows these differences. During the first two or three weeks after harvesting begins comparatively few fruits are borne, but it is very desirable that these be removed at frequent intervals while small. The fewer the cucumbers allowed to become full grown, the more the vines will bear. The frequency with which pickling cucumbers must be harvested depends somewhat upon weather conditions, but it is often necessary to pick every day. Small cucumbers, those from 1 to 3 inches in length, are worth about three times as much per pound as large ones, and it is to the advantage of the grower to gather his cucumbers often enough to have the greatest possible proportion within the first grade. Furthermore, frequent harvesting is extremely desirable, because it prevents the development of large fruits, which deplete the vitality of the plant.

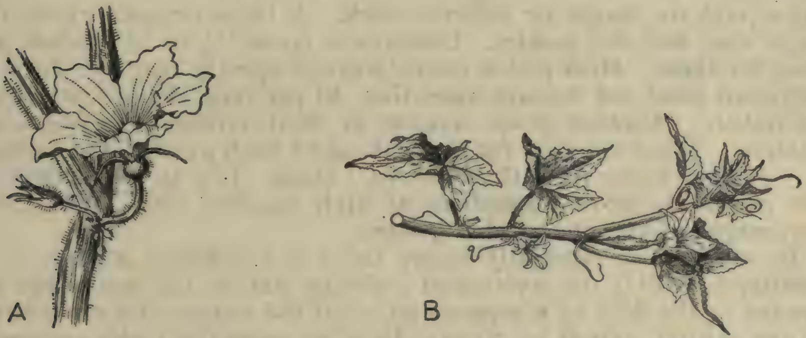

FIGURE 9.—Flowers of the cucumber: A, Male or staminate; B, female or pistillate flower

Planting in hills and wide spacing are distinct helps in harvesting cucumbers for pickling. (Figs. 3 and 4.) Under such conditions it is easy to find all the fruits before they become too large.

Picking cucumbers at the stage for pickling is a rather slow and laborious task, this phase of the work being responsible for the fact that cucumbers for this purpose are usually grown in small areas, because it is difficult to obtain help to harvest large fields. Emphasis is placed upon the desirability of wide spacing and thinning to single plants as aids in harvesting, because the pickers can easily examine all parts of the plants. When the cucumbers are planted close, as shown in Figure 5, all cultural operations are difficult, and it is practically impossible to find a large part of the fruits before they become too large. The daily picking from the acre or two in the average-sized cucumber patch can be easily transported to the collecting or the salting station in a buggy or a light automobile and presents no difficulties.

Practically all cucumbers for pickling are grown under contract between a pickle company and the farmer. The buyer specifies the grades into which the cucumbers shall be divided and the price paid for each grade. The best pickling cucumbers are from 1 to 3½ inches in length, straight, cylindrical in shape, and count not less than 850 to each 50 pounds. This grade commands about three times the price paid for larger or inferior stock. A large demand exists for large sour and dill pickles. Cucumbers from 3½ to 5½ inches are used for these. Most pickle manufacturers specify that the stock as delivered must not contain more than 40 per cent of these oversized cucumbers. Another grade consists of small crooked specimens, or nubbins. These are used for the making of chop pickles, and as such they bring a lower price than the No. 1 stock. It is to the interest of the grower to grow cucumbers of high quality, with a minimum percentage of the undesirable grades.

In some cases, especially where there is insufficient acreage in a locality to justify the erection of a salting station, the cucumbers are graded in the field by a representative of the buyer, who sends them to the salting station by truck. In other cases the pickle company maintains a collecting station (fig. 2) where the stock is received and paid for and afterwards hauled to the salting station (fig. 1), where the cucumbers are brined and held until needed. As salt-stock pickles can be kept for more than one season, it is possible to bridge over seasons of low and high production without violent fluctuations in the prices paid to producers. Most pickle companies encourage their growers in every possible way, as they are anxious to maintain production in localities where they have established salting stations.

YIELDS AND RETURNS

The average yield of pickling-crop cucumbers in the United States over a period of several years is about 50 bushels per acre; however, good growers frequently obtain from 100 to 150 bushels per acre.

Prices paid for the stock vary widely, depending upon the locality and the grade of the cucumbers; but $1 to $3.50 per hundred pounds, the price depending on the grade, represents the prevailing practice. On this basis it is apparent that a successful grower may obtain a gross return of $150 to $200 per acre.

The main item of money outlay in growing cucumbers is for fertilizer, unless extra labor is hired for harvesting; but this work is usually done by the members of the family.

Cucumbers for pickling are a cash crop and especially attractive to persons who wish to supplement their regular farm income. The young man shown in Figure 3 made $150 during 1927 on the 1½-acre cucumber patch shown in the illustration. Figure 4 shows a 2½-acre patch grown on rented land by a school teacher who occupied a part of his vacation in this manner. Success in the work depends on a location having the right soil and climatic conditions and upon its nearness to a salting station.

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March 21, 1930

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VARIETIES OF HARD RED SPRING WHEAT[1]

By J. Allen Clark

Senior Agronomist, Office of Cereal Crops and Diseases, Bureau of Plant Industry

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THE HARD RED SPRING CLASS OF WHEAT

WHEAT IS SEPARATED into five classes under the official grain standards of the United States. The first class is designated as hard red spring. About 22 per cent of the wheat acreage of the United States is of this class. The varieties which make up this important class of wheat are distinguished by having hard red kernels and are grown from spring sowing, chiefly in the north-central part of the United States. There are 23 registered varieties grown. Flour of high bread-making quality is manufactured from the principal hard red spring varieties.

WHERE HARD RED SPRING WHEATS ARE GROWN

The States leading in the growing of hard red spring wheat varieties are North Dakota, Montana, South Dakota, and Minnesota, in the order named. A considerable acreage is grown also in Iowa, Illinois, Wisconsin, Nebraska, Colorado, Wyoming, Idaho, Washington, and Oregon, and smaller quantities of but little commercial importance in six other States. A map of the United States showing the distribution of hard red spring wheat in 1924 is shown as Figure 1. Each dot on the map represents 2,000 acres of this class of wheat. The acreage sown in 1924, which was estimated to be 11,396,140 acres, was slightly smaller than that in a normal year.

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[1] The information given in this bulletin is based upon (1) varietal experiments conducted by the Office of Cereal Crops and Diseases, of the Bureau of Plant Industry, U. S. Department of Agriculture, and the State agricultural experiment stations, either independently or in cooperation; (2) classification studies of all American wheat varieties; (3) a survey of the wheat varieties of the United States grown in 1924 in cooperation with the Bureau of Agricultural Economics, based upon about 6,500 returns from questionnaires sent to crop correspondents; (4) several years of personal observation of the wheat fields in the States where these varieties are grown; and (5) milling and baking experiments conducted by the milling and baking investigations section and the research laboratory of the Grain Division, Bureau of Agricultural Economics, in cooperation with the Office of Cereal Crops and Diseases, and also by State agricultural experiment stations and by commercial mills.

WHERE HARD RED SPRING WHEATS ARE ADAPTED

Hard red spring wheats are best adapted to the northern and colder regions of the United States. In much of the principal producing area, which includes four States—North Dakota, Montana, South Dakota, and Minnesota—the winters are too cold for the profitable production of winter wheat.

Wherever the winters are not too severe, winter or fall-sown wheat usually is more productive than spring wheat. This is due chiefly to the earlier maturity of winter wheat, which partly enables it to escape hot weather, drought, and diseases, but it is due in part also to the longer growing period of the winter wheat. Spring wheat, therefore, is adapted chiefly to the northern regions where winter wheat is not successfully grown or where it supplements the growing of winter wheat. In northern areas, where both winter and spring wheat can be successfully grown, the growing of both affords a better distribution of labor and lessens the seasonal risk. Spring wheat sometimes is sown in the northern areas on land where the fall-sown wheat has winterkilled.

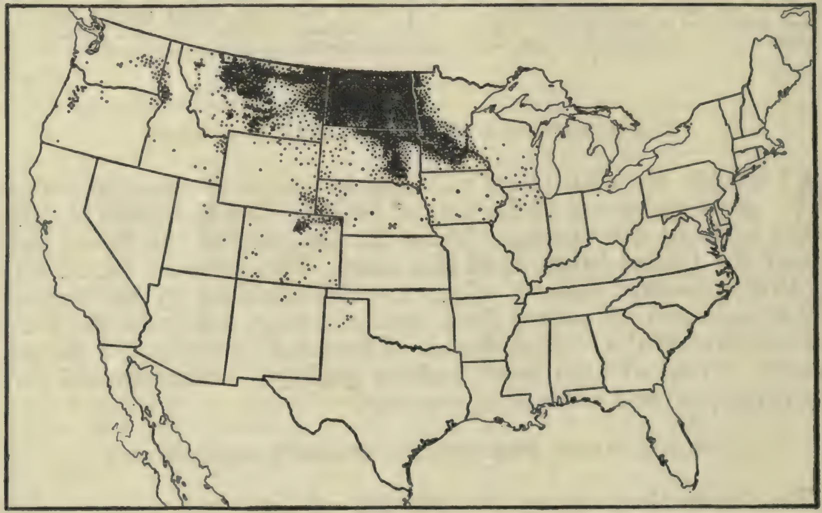

FIGURE 1.—Outline map of the United States, showing where hard red spring wheat was grown in 1924. Each dot represents 2,000 acres or fraction thereof per county. Estimated area, 11,396,140 acres

In the Corn Belt winter wheat is more productive than spring wheat, but certain hard red spring varieties are much more productive than any other classes of spring wheat. Hard red spring wheat is not successfully grown south of the Corn Belt.

In the northern part of the intermountain region and in the Pacific Northwest certain varieties of hard spring wheat are fairly successful. In most of these regions, however, the yields of hard red spring wheats are less than those of winter wheats or certain white spring varieties of common and club wheats. In the irrigated sections of these regions hard red spring varieties yield comparatively less than on the dry lands. In California and other

Southwestern States hard red spring wheats are not adapted and are grown only to a slight extent, usually from fall sowing.

The hard red spring is the most productive class of wheat in Minnesota and Wisconsin and in the New England States. In the eastern parts of North Dakota and South Dakota and in the northern Great Plains area the durum wheats yield somewhat more than the best hard red spring varieties, principally because of their greater resistance to drought and to stem rust. In favorable years, however, the leading hard spring varieties yield nearly as well as the durum varieties grown in these districts. The higher price which often prevails for the hard red spring wheat makes the net returns per acre from hard spring wheats nearly as much as from the durum varieties. There usually has been greater domestic demand for hard red spring wheat than for wheat of other classes, because of the high quality of flour it produces.

In general, the hard red spring wheats are best adapted to the areas of more concentrated production, as shown in Figure 1. In the northern Great Plains area, where the durum wheats outyield the hard red spring varieties, the class of wheat grown will largely depend upon the relative market price.

VARIETIES

There are 23 recognized or registered varieties of hard red spring wheat commercially grown in the United States. These are known under about 60 different names. Several additional distinct varieties are grown which have not been recognized by being registered as standard or improved varieties. New varieties are registered, on the basis of performance, under a cooperative agreement between the Bureau of Plant Industry, United States Department of Agriculture, and the American Society of Agronomy.

The varieties of hard red spring wheat differ widely in their yielding ability, rust resistance, earliness, and milling and baking value, as well as in their structure and appearance. Some varieties of similar appearance differ in origin and adaptation. For convenience in describing them the varieties of hard red spring wheat are divided into five groups on the basis of head and chaff characters.

DISTINGUISHING CHARACTERS OF GROUPS OF VARIETIES

Group 1.—Heads beardless; chaff smooth, white or yellow: Marquis, Red Fife, Power, Red Bobs, Kitchener, Ruby, Garnet, Supreme, Marquillo, Huston, Kinney.

Group 2.—Heads beardless; chaff velvety, white or yellow: Haynes Bluestem, Reward.

Group 3.—Heads bearded; chaff smooth, white or yellow: Preston, Kota, Ceres, Reliance, Hope, Java, Progress.

Group 4.—Heads bearded; chaff smooth, brown or red: Ladoga.

Group 5.—Heads bearded; chaff velvety, white or yellow: Prelude, Humpback.

Group 1.—HEADS BEARDLESS; CHAFF SMOOTH, WHITE OR YELLOW

The varieties of Group 1 are the most extensively grown of all the hard red spring wheats. They are somewhat similar in appearance, and most of them are closely related. The heads are beardless and slender. In general, they vary in length from 3 to 3½ or 4

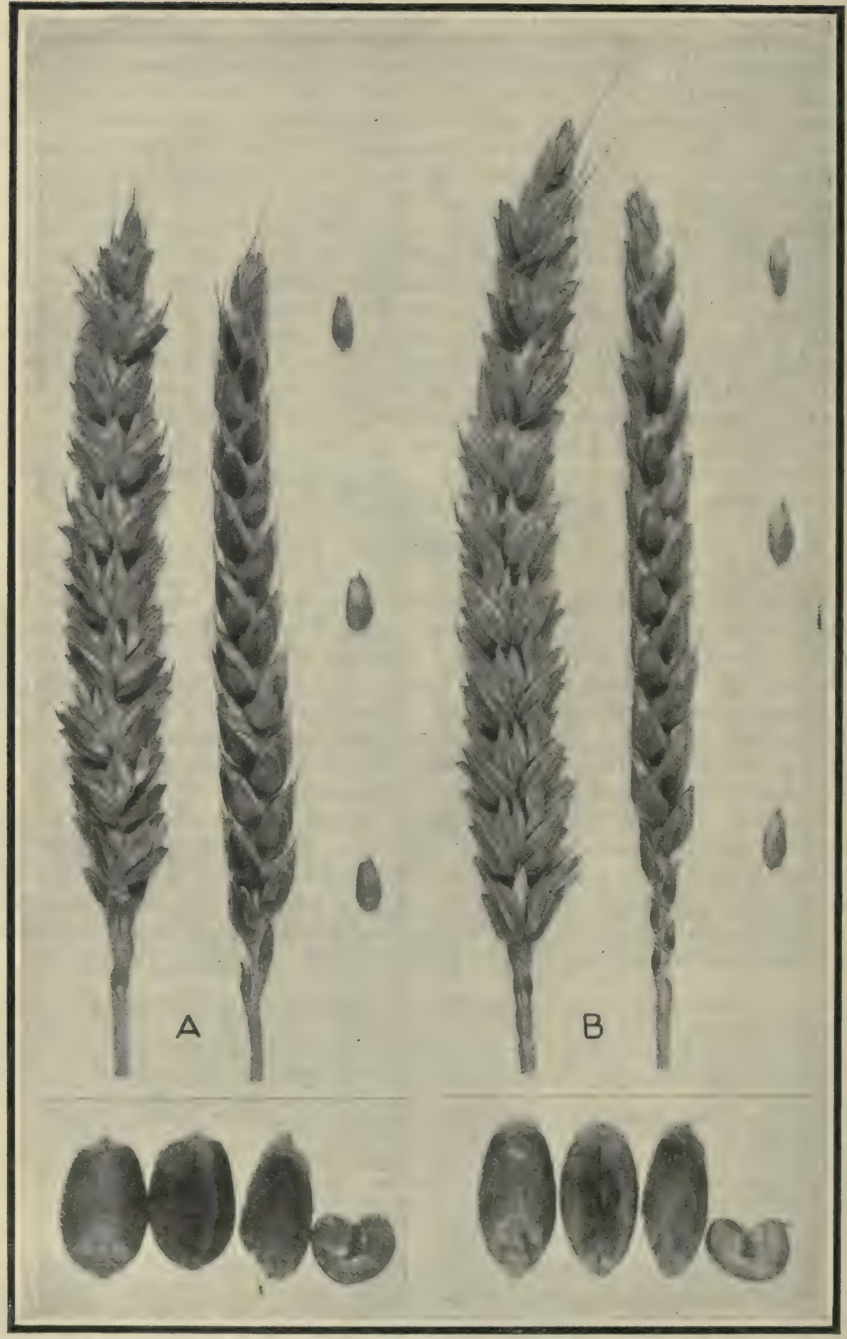

FIGURE 2.—Heads, chaff, and kernels of Marquis (A) and Red Fife (B) wheats. Heads and chaff, natural size; kernels, magnified 3 diameters

inches. The chaff is white and smooth (not velvety or hairy), and the kernels are rather short, small to medium sized, have an angular or irregular appearance, are very hard, and are mostly of a dark-red color. The following registered varieties in this section are not separately considered, as they are no longer commercially grown: Early Red Fife, Ghirka, Glyndon, Rysting, and Wellman. The commercial varieties in this section are described in the following paragraphs.

MARQUIS

Marquis is the most important variety of hard red spring wheat. Although it has been grown in the United States only since 1913, it has been the leading spring-wheat variety since 1919 and is exceeded in acreage by only one variety of winter wheat. Approximately 9,600,000 acres of Marquis wheat were grown in the United States in 1924.

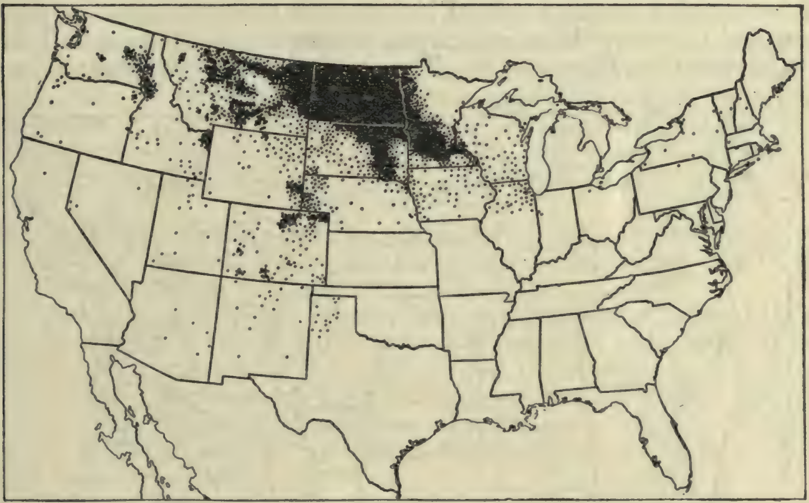

FIGURE 3.—Distribution of Marquise wheat in 1924. Each dot represents 1,000 acres or fraction thereof per county. Estimated area, 9,605,870 acres

The Marquis variety has rather short straw, heads, chaff, and kernels. It matures fairly early, which sometimes enables it partly to escape rust and drought. Like all varieties in this group, it has beardless heads, smooth, white chaff, and red kernels. (Fig. 2, A.) The chaff is rather firm, so the heads are not easily shattered.

Marquis is a selection from a hybrid produced by crossing a hard red wheat from Calcutta, India, and the well-known Red Fife. The cross was made by A. P. Saunders about 1892. The Marquis was selected and named by Charles E. Saunders, Dominion cerealist, and was first grown as a pure line at Ottawa, Canada, in 1904. The commercial growing of Marquis wheat in Canada began in 1909.

The Marquis variety was reported as being grown in 29 States in the United States in 1924. It is the leading variety of wheat in Minnesota, Montana, North Dakota, South Dakota, Wisconsin, and Wyoming. The distribution of Marquis wheat grown in the United States in 1924 is shown in Figure 3.

Marquis has produced high average yields in comparison with other hard red spring varieties in nearly all areas where this class of wheat is grown. In a few localities within the hard red spring wheat region other varieties have yielded as well or slightly better. Marquis wheat is not well suited to growing on poor soil, and it is not resistant to stem rust. It is resistant to leaf rust, however, and to bunt or stinking smut.

Marquis when grown under favorable conditions produces plump kernels containing a high percentage of crude protein and yielding a good percentage of flour.

In the quality of flour for bread making Marquis excels most other varieties of wheat grown in the United States. The bread produced from this wheat has a large expansion and good texture and color.

RED FIFE

The Red Fife variety (known also as Canadian Fife, Fife, Saskatchewan Fife, and Scotch Fife) differs from Marquis in being somewhat taller and later and having longer heads and kernels. Red Fife is shown in Figure 2, B. The original Red Fife wheat is supposed to have come from Poland or Russia by way of Germany and Scotland. About 1842, David Fife, of Otonabee, Ontario, Canada, received a small sample of wheat from a friend in Glasgow, Scotland. The friend had obtained the sample from a shipload of wheat from the German port of Danzig, but supposedly of Russian origin. Mr. Fife sowed the wheat in the spring, but it proved to be a winter wheat. One plant of spring wheat developed, however, which was saved and increased. This was the beginning of the Red Fife wheat, which came to be widely grown in Canada. Samples of wheat identical with Red Fife were received independently in 1904 from Galicia (now a part of Poland) by the Canadian Department of

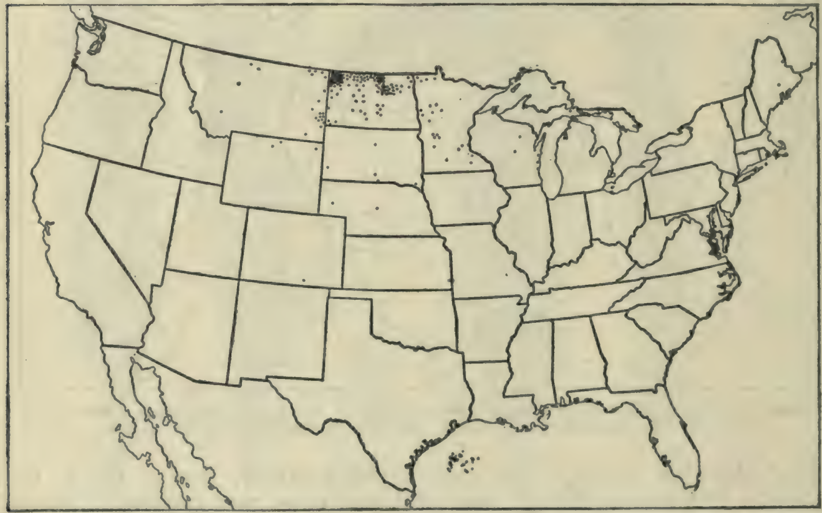

FIGURE 4.—Distribution of Red Fife wheat in 1924. Each dot represents 1,000 acres or fraction thereof per county. Estimated area, 175,008 acres

Agriculture and the United States Department of Agriculture. The cultivation of Red Fife in the United States began in 1860. Prior to the introduction of Marquis it was the leading spring wheat. The Red Fife variety was often grown and distributed under the names of growers. Most of these were only similar pure stocks of this variety, but from them were developed several distinct strains, formerly of considerable importance.

In 1919 the estimated acreage of Red Fife was nearly a million acres, but by 1924 its estimated area had been reduced to 175,000 acres. The distribution of this acreage is shown in Figure 4.

POWER

Power (Power Fife) is nearly identical with Red Fife, except that in the length of the head and kernel it is shorter and more similar to Marquis. The original Power Fife was developed from a single plant found growing in an oat field by James Holes, of Fargo, N. Dak., about 1885. Some of this seed was obtained by J. B. Power, of Power, N. Dak., who increased it and distributed it in large quantities under the name Power Fife. The North Dakota Agricultural Experiment Station, which grew this wheat under the designation of Station No. 66, made some selections from it and distributed one of them from the Williston substation as Power or North Dakota No. 313, which is the origin of most of this variety now grown.

Power is commercially grown only in North Dakota and Montana. The extent of its distribution is not definitely known, owing to its confusion with other Fife wheats.

In varietal experiments Power has produced somewhat higher yields than Red Fife. It has exceeded Marquis in yield only in the northwestern portion of North Dakota and the northeastern portion of Montana. Power has a high percentage of protein, but milling and baking experiments have shown that Power is slightly inferior in milling and baking value to Red Fife and consequently considerably inferior to Marquis.

RED BOBS

Red Bobs usually can be distinguished from other varieties in this group because of the absence of short beards on the tip of the head. (Fig. 5, A.) The heads of practically all beardless wheats have short beards, varying from ¼ to 1 inch in length, near the tips of the heads. Most of the heads of Red Bobs, however, do not have these short beards. The variety was not pure in this and other minor respects when it was distributed. Red Bobs matures several days earlier than Marquis. The kernels of the two varieties are almost identical, except that the brush (the hair on the tip of the kernel) of Red Bobs is shorter.

Red Bobs originated from a head found in a field of Bobs, a white wheat, in 1910, by Seager Wheeler, at Rosthern, Saskatchewan, Canada. It probably is the result of a natural field hybrid between Bobs and Marquis. Red Bobs was first distributed in 1918. In 1924 about 15,000 acres were estimated to be grown in the United States. The experiments and trials by farmers have shown that it is very sus-

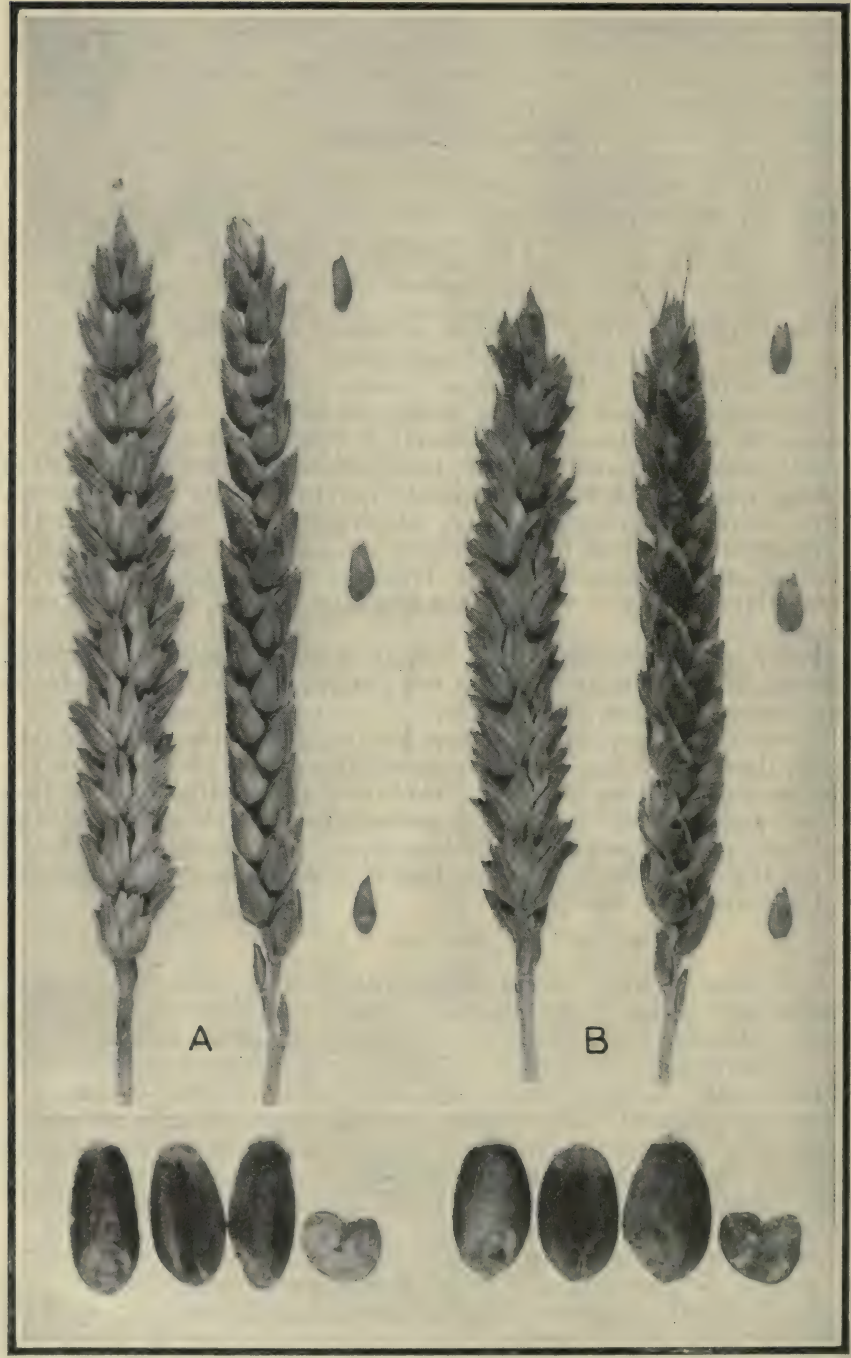

FIGURE 5.—Heads, chaff, and kernels of Red Bobs (A) and Kitchener (B) wheats. Heads and chaff, natural size; kernels, magnified 3 diameters

ceptible to stem rust and adapted only to the northern and drier sections of Montana, where rust does not occur.

In experiments in central and northern Montana Red Bobs has outyielded Marquis. Under conditions of drought Red Bobs usually yields more than Marquis, owing principally to its earlier maturity. Where rust is likely to occur, as in Minnesota and the Dakotas, Red Bobs should not be grown, as usually it yields much less than Marquis.

Red Bobs is a good wheat for milling and baking. In yield of flour it is nearly equal to Marquis when grown under the same conditions. The quality of Marquis flour, however, is superior to that of Red Bobs. The former as a rule has a higher protein content and produces a larger loaf of bread.

KITCHENER

Kitchener differs from Marquis in being slightly later and taller and in having a purple straw and a slightly longer kernel. The chief difference, however, is in the tip of the head of Kitchener, which is square or somewhat clubbed (fig. 5, B), instead of pointed like that of Marquis.

Kitchener originated from a head of wheat found in a field of Marquis in 1911, by Seager Wheeler, at Maple Grove Farm, Rosthern, Saskatchewan, Canada. It was increased by Doctor Wheeler and distributed about four or five years later.

Kitchener is grown to some extent in Canada and the United States. It is scarcely equal to Marquis in any respect, and it is later in maturing and more susceptible to injury by stem rust. In the eastern, more humid, and rust-affected section of the spring-wheat area it has yielded considerably less than Marquis. Only in Montana has it shown any superiority over Marquis in yield, and as it is slightly taller and thus usually easier to harvest, it is preferred by some growers for that section.

In comparative tests Kitchener has proved to be somewhat inferior to Marquis in both milling and baking qualities. It is a better milling and bread-making wheat, however, than the Fife strains.

RUBY

Ruby matures about five days or sometimes a week earlier than Marquis. It also can be distinguished from Marquis by the purple straw at maturity. The grain of the two varieties can scarcely be distinguished.

Ruby was originated by Charles E. Saunders, Dominion cerealist, at the Central Experimental Farm, Ottawa, Canada. It is the result of a cross between Red Fife and a hybrid wheat known as Downy Riga. It was first

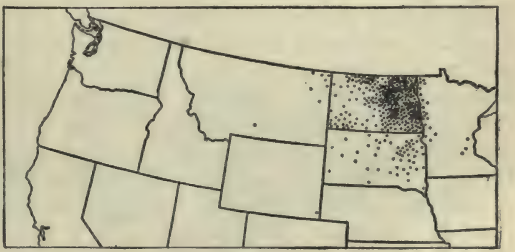

FIGURE 6.—Distribution of Ruby wheat in 1924. Each dot represents 1,000 acres or fraction thereof per county. Estimated area, 329,958 acres

distributed in Canada in 1917 and in the United States in 1921. In 1924 there was estimated to be about 330,000 acres of Ruby grown in the United States. As a rule, however, it has produced lower yields than Marquis, due to its earlier maturity and greater susceptibility to stem rust. The distribution of Ruby wheat in 1924 is shown in Figure 6. Since 1924 its acreage has rapidly decreased.

GARNET

Garnet was produced from a hybrid between Preston and Riga made in 1905 by Charles E. Saunders, then Dominion cerealist of Canada. It was first included in experiments in Canada in 1914. The advantage of Garnet is its early maturity—it is 8 to 10 days earlier than Marquis. In 1926 it was introduced by L. H. Newman, Dominion cerealist, for commercial growing to avoid frost injury. Garnet is now grown in many sections of Canada, and since 1927 it has been grown to a small extent in the United States to meet a limited demand for an early wheat.

In the experiments in North Dakota and Montana, where it is best adapted, Garnet has not yielded so well as Ruby or Marquis. The quality of Garnet also is not so good as that of other early wheats, particularly Reward. The further distribution and growing of Garnet wheat in the United States, therefore, should be discouraged.

SUPREME

Supreme was developed as a selection from Red Bobs by Seager Wheeler at Rosthern, Saskatchewan, Canada. It is uniform in type of head, being completely beardless (fig. 7, A) and similar to most of the types present in Red Bobs. It has a dark-green color of stem and leaf when green and is shorter than some of the types of plant in Red Bobs. It has outyielded Marquis and Red Bobs in Montana, where it is recommended by the experiment station and preferred by many growers. It is four to seven days earlier than Marquis, has stronger stems, and is about equal in milling and baking quality. The crude protein content of Supreme usually is less than that of Marquis, however, due partly to differences in yield. Supreme, like Red Bobs, is susceptible to stem rust and should not be grown in Minnesota and the Dakotas, where rust is likely to occur.

MARQUILLO

Marquillo (fig. 7, B) was developed at the Minnesota Agricultural Experiment Station in cooperative experiments with the Office of Cereal Crops and Diseases, Bureau of Plant Industry. It is the result of a cross made in 1914 between Marquis and Iumillo durum. The selection was made in 1918, and the variety has been grown in experiments in Minnesota and other States since 1921. The advantages of Marquillo are its resistance to stem rust and its strong straw. It has outyielded Marquis in Minnesota and is best adapted in that State and to the heavier soils where rust and lodging are serious factors. It was distributed in 1929 for commercial growing by the Minnesota Agricultural Experiment Station. Its adaptation will probably be limited to the valley sections of Minnesota and eastern

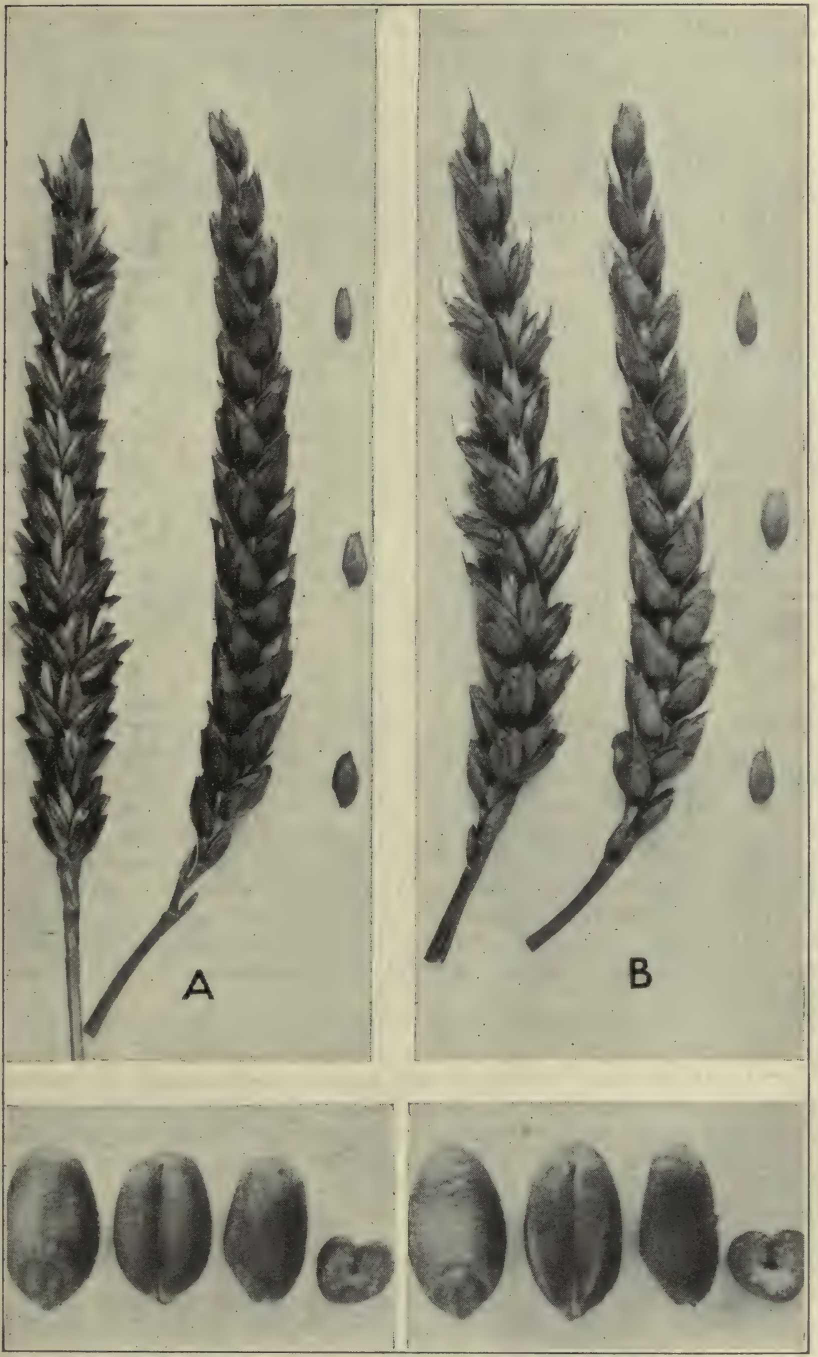

FIGURE 7.—Heads, chaff, and kernels of Supreme (A) and Marquillo (B) wheats. Heads and chaff, natural size; kernels, magnified 3 diameters

North Dakota. In other sections it does not yield so well as other varieties. The protein content of Marquillo grain is high in comparison with that of other varieties, and its milling and baking qualities are good except that it produces a yellowish flour which requires bleaching.

HUSTON

Huston (known also as Bulgarian, Early Wonder, Grass, Little Red, Ninety-Day, Red Springs, and Swamp) differs from most other varieties included in Group 1 in having small heads and rather soft kernels. The straws show a faint tinge of purple at maturity. The kernels show a characteristic central pit or opening in the crease.

Huston was obtained by a Mr. Belshaw in 1876 from the Centennial Exposition at Philadelphia, Pa., where it was on exhibition as Bulgarian Red Spring. It was introduced into the vicinity of Eugene, Oreg. After increasing the seed the crop was given to a Mr. Huston, who grew and distributed the variety.

Huston now is generally grown in western Oregon, but apparently it has not been successful elsewhere. None of it is grown in the northern hard spring wheat region. This variety succeeds best on the foothill lands in the Willamette Valley of Oregon and is the best spring wheat for that district. The milling and baking value of Huston is inferior to that of Marquis and to most other hard spring varieties. It sometimes is grown from fall seeding and sold and graded as soft red winter wheat.

KINNEY

Kinney (known also as Noah Island, Odessa, and Surprise) is classed as a hard red spring wheat, although, like Huston, it differs widely from the varieties previously discussed. It is a late wheat, having square heads and a rather soft, wide kernel. The stems and leaves of this variety have a distinct bloom or white waxy covering (such as occurs on sorghums, plums, etc.) just before ripening.

Kinney was introduced into the Willamette Valley of Oregon from France during the late sixties or early seventies by Albert Kinney, who at that time was associated with his father in the milling business. It was distributed by Mr. Kinney to farmers in the vicinity of the mill.

Kinney, as far as known, is grown only in the Willamette Valley of Oregon, where it is sown in both spring and fall. It is not grown in the northern hard spring wheat region, and because of its late maturity it is not adapted there. Kinney is one of the leading varieties of wheat in the district where it is grown, but experiments have shown its yield to be less than that of Huston and several other varieties. Outside of this humid section of Oregon Kinney is not adapted.

Group 2.—HEADS BEARDLESS; CHAFF VELVETY, WHITE OR YELLOW

The wheats of Group 2 differ from those in Group 1 of this bulletin in having velvety chaff. Only two varieties are discussed in this group. They differ widely in their time of maturity. Dakota or Select Bluestem, N. Dak. No. 316, is not described, as it is no longer commercially grown.

HAYNES BLUESTEM

The name Haynes Bluestem is now applied to the original Bluestem as well as to the selected strain known as Haynes Bluestem. Other names applied to the variety are Bolton Bluestem, Marvel Bluestem, Minnesota No. 169, and Velvet Bluestem. This variety has large beardless heads, velvety white chaff, and rounded hard red kernels. It shatters easily and is of late maturity. (Fig. 8.)

Haynes Bluestem was selected from the bulk Bluestem variety in 1883 by L. H. Haynes, of Fargo, N. Dak. This wheat was first distributed about 1892 and soon became widely grown in Minnesota and the Dakotas. Selections from this wheat made at the Minnesota Agricultural Experiment Station were increased and distributed by that station during the late nineties as Minnesota No. 169 or Haynes Pedigreed Bluestem.

Haynes Bluestem, under one or another of its names, is now grown to only a limited extent throughout the northern spring-wheat region. About 133,000 acres of this variety were grown in 1924. (Fig. 9.) It was formerly extensively grown and considered a high-yielding variety in Minnesota and the eastern Dakotas. In the Great Plains area it always has been a poor yielder, owing to its late maturity and consequent injury from summer drought. Since the introduction of Marquis, the acreage of Haynes Bluestem has rapidly decreased.

Since 1915 stem rust has caused serious injury to

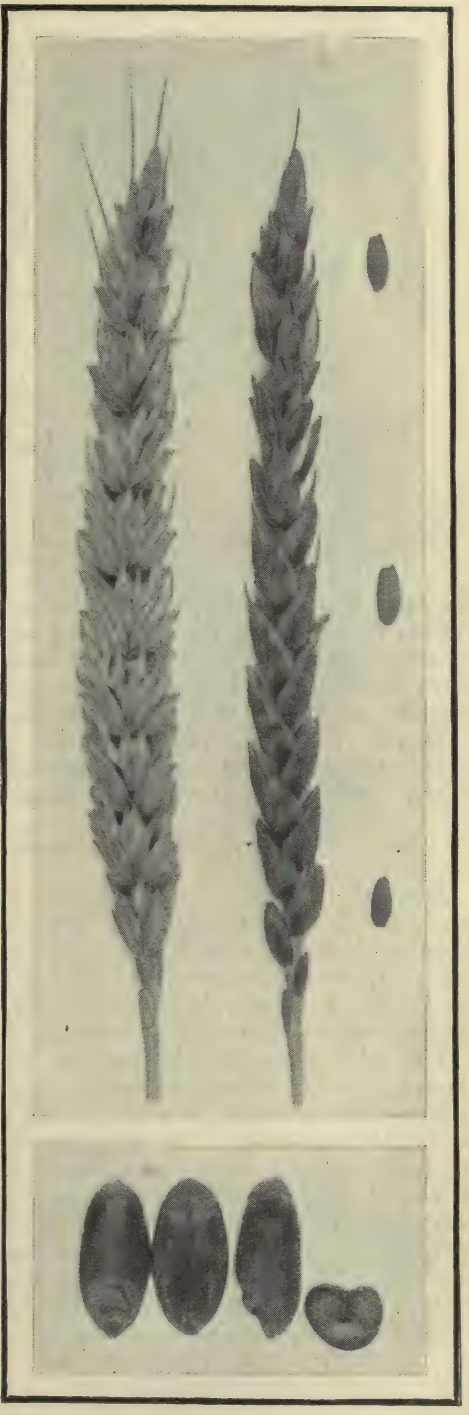

FIGURE 8.—Heads, chaff, and kernels of Haynes Bluestem wheat. Heads and chaff, natural size; kernels, magnified 3 diameters

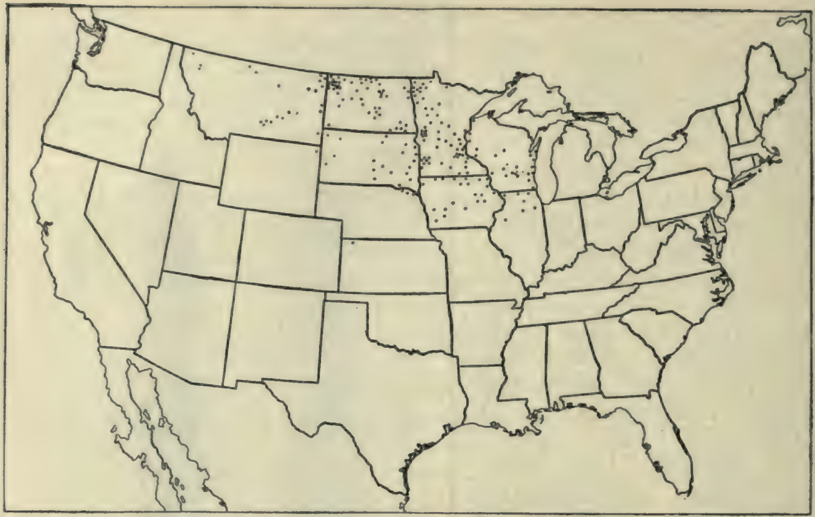

FIGURE 9.—Distribution of Haynes Bluestem wheat in 1924. Each dot represents 1,000 acres or fraction thereof per county. Estimated area, 133,031 acres

Haynes Bluestem in some sections of the northern spring-wheat region nearly every year. During recent years the variety has given comparatively low yields, and its acreage has continued to be reduced since 1924 until it has nearly disappeared from cultivation. Under present conditions it is not advisable to grow this wheat.

Haynes Bluestem has long been considered a good milling and bread-making wheat. Experiments have shown, however, that it is slightly inferior to Marquis for these purposes.

REWARD

Reward (fig. 10) was produced from a Marquis×Prelude cross made in 1911 by Charles E. Saunders. It has been tested at the Dominion experiment farms and stations throughout Canada since 1921. It was distributed in 1927 for commercial growing in Canada by L. H. Newman, Dominion cerealist. It was first grown to a limited extent in the United States in 1928.

The advantages of Reward are its early maturity and its large plump kernels of exceptionally high quality. It is now recommended for growing in Canada and is preferred to Garnet because of its better quality, in spite of slightly lower yields. Its early maturity enables it to escape frost injury in northern Canada, and it was for this purpose that it was developed. In the United States early maturity usually results in lower yields. While the yields of Reward are comparatively low in comparison with the best hard red spring varieties in the United States, it appears probable that it may meet the demand for an early, high-quality wheat for the drier marginal sections. Reward also has shown promise, because of its early maturity and stiff straw, on heavy valley soils where stem rust and lodging are serious factors in production. The payment of premiums for high-protein wheat also may result in the growing of

Reward wheat in areas where these premiums would more than compensate for the reduction in yields. At the present time Reward is known to have the highest protein content of any of the commercial varieties of hard red spring wheat grown in the United States.

Group 3.—HEADS BEARDED; CHAFF SMOOTH, WHITE OR YELLOW

Group 3 includes several distinct varieties. Most of them mature early or in midseason. The kernels vary, but in general are rather plump, heavy in weight per bushel, of dull-red color, and of less angular appearance than the wheats included in Group 1. In texture they vary from almost soft to very hard and in size from small or short to very large or long. The following registered varieties in this group are not separately considered, as they are no longer commercially important: Champlain, Chul, Converse, Dixon, Erivan, Fretes, and Pioneer. One of the most widely grown varieties in this group is Preston, which commonly is called Velvet Chaff.

PRESTON

Preston (Velvet Chaff, known also as Bearded Fife, Blue Ribbon, Climax, Golden Drop, Johnson, Johnson's Early Fife, Minnesota No. 188, and Red Fife) has bearded, tapering heads, about 3½ to 4 inches long, and midsized hard red kernels. The kernel can be distinguished by the dull-red color and the rather narrow V-shaped crease. Preston matures in about the same length of time as Red Fife, being a few days later than Marquis. A spike, glumes, and kernels of Preston are shown in Figure 11, A.

Preston was developed from a cross between Ladoga and Red Fife

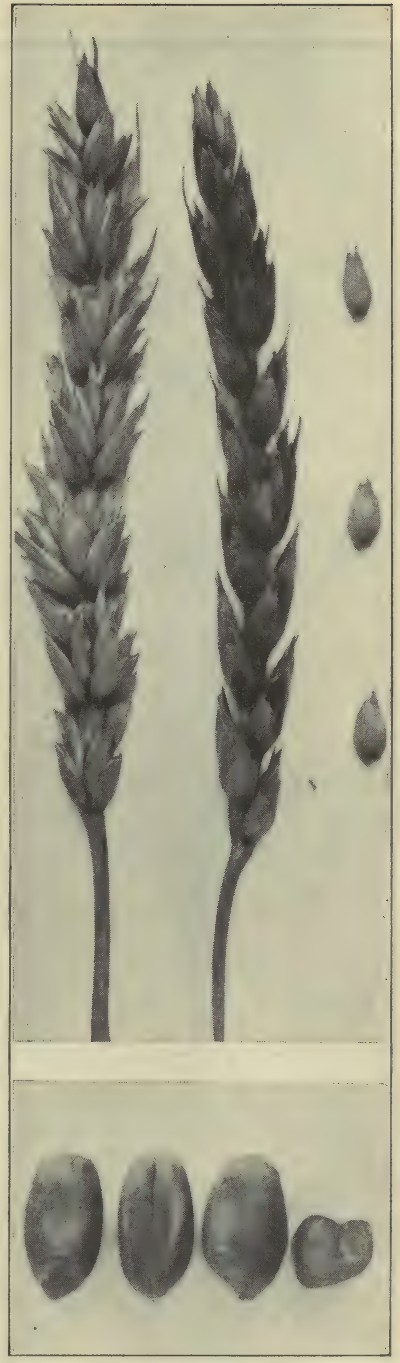

FIGURE 10.—Heads, chaff, and kernels of Reward wheat. Heads and chaff, natural size; kernels, magnified 3 diameters

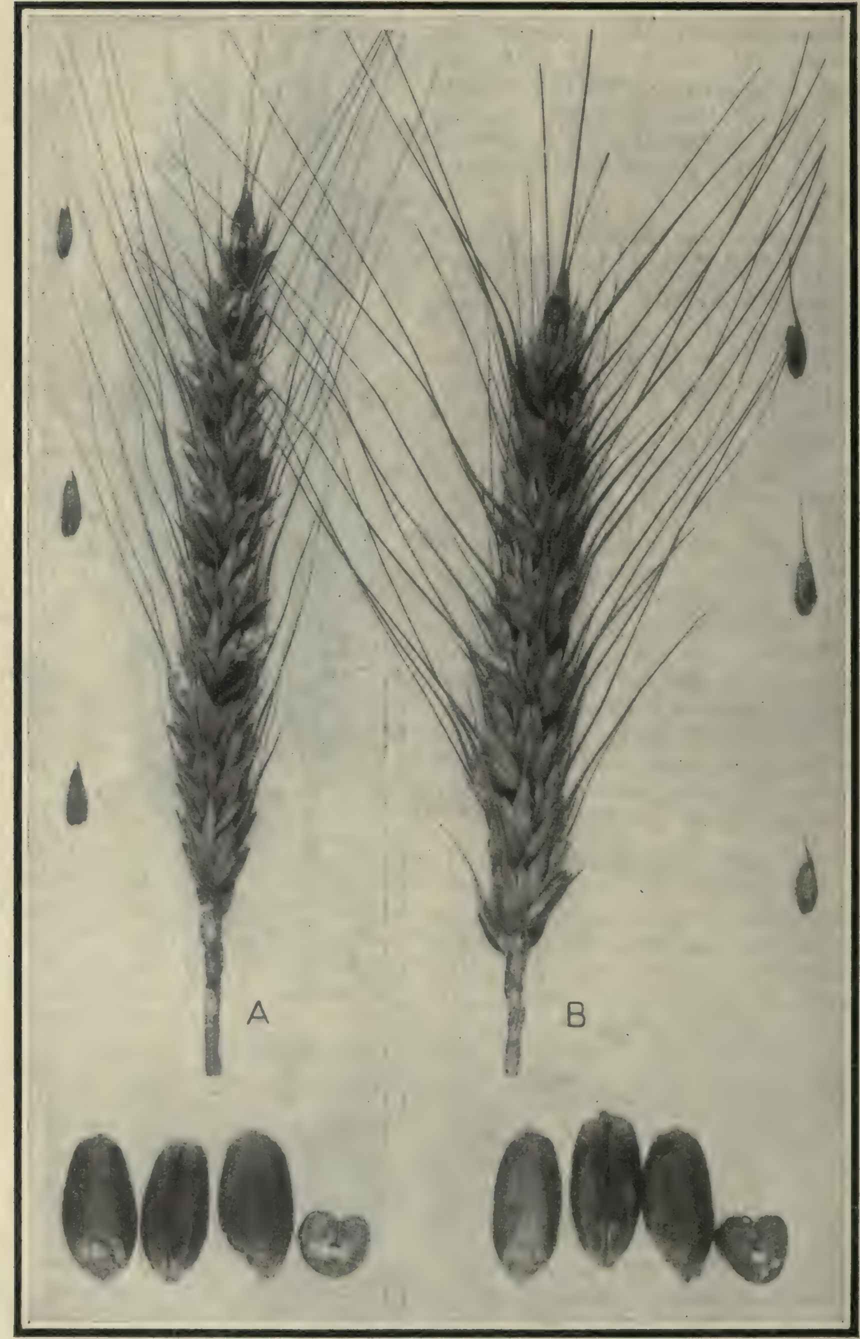

FIGURE 11.—Heads, chaff and kernels of Preston (A) and Kota (B) wheats. Heads and chaff, natural size; kernels, magnified 3 diameters

made by William Saunders at the Central Experimental Farm, Ottawa, Canada, in 1888. After being selected, this wheat was distributed in Canada and also sent to the Minnesota Agricultural Experiment Station in 1896, from which station it was later distributed to farmers of that State as Minnesota No. 188. Other similar wheats, called Johnson and Golden Drop, which can not be distinguished from Preston, were grown in the United States prior to this introduction of Preston. These wheats, however, were not pure, as they contained other types, and the name Johnson had sometimes been used for the Java variety. Java also contained mixtures similar to Preston. The exact history of the spring wheat commonly called "Velvet Chaff" in this country is somewhat uncertain, therefore, although it is identical with the Preston wheat of Canada. In Wisconsin a selection of this wheat is grown under the name of Blue Ribbon.

Preston (or so-called "Velvet Chaff") was formerly grown throughout the northern spring-wheat region, and especially in the Red River and Minnesota River Valleys. Its distribution in 1924 is shown in Figure 12. It was estimated that 2,245,200 acres were grown in 1919 but only 392,176 acres in 1924. Since 1924 its acreage has continued to decrease. In the Red River Valley of Minnesota and North Dakota and in the Minnesota River Valley of Minnesota Preston has yielded nearly as high as Marquis and occasionally higher than that variety. In general, however, Marquis has given higher yields. Preston is very susceptible to stem rust, and it is largely for this reason that its acreage has rapidly declined.

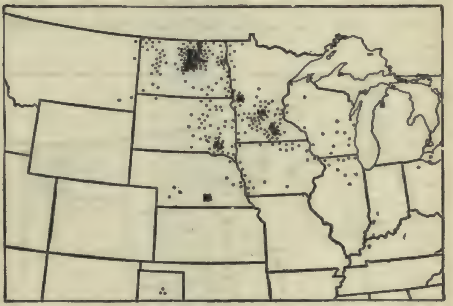

FIGURE 12.—Distribution of Preston wheat in 1924. Each dot represents 1,000 acres or fraction thereof per county. Estimated area, 392,176 acres

Preston produces a plump kernel which under average conditions weighs about 1½ pounds per bushel more than Marquis grown in the same locality. This is not true under very favorable conditions, however. Nevertheless, the heavier bushel weight frequently results in a higher market grade for Preston. Owing partly to its high bushel weight Preston usually produces a larger percentage of flour than Marquis. The variety, however, is inferior to Marquis in protein content and in baking quality, though experiments show it to be about equal to Red Fife and Haynes Bluestem in these characters.

KOTA

Kota is resistant to the forms of black stem rust that predominate in the northern spring-wheat region. It is susceptible, however, to the less-damaging orange leaf rust and to both stinking smut and loose smut. Aside from its resistance to stem rust Kota differs from Preston in having longer beaks and a more elevated shoulder on its outer glumes. The beaks of Kota average about one-half inch long, while those of Preston average only about one-eighth inch in length. Kota has a slightly weaker straw and is more easily lodged than Preston, and the kernels are longer, harder, and more angular. A spike, glumes, and kernels of Kota are shown in Figure 11, B.

The original seed was obtained in Russia in 1903 by H. L. Bolley, of the North Dakota Agricultural College, while making a study of the flax industry of Europe for the United States Department of Agriculture. In the years immediately following its introduction this wheat was not known to have any special merit. After the rust epidemic of 1916, mixtures of it in Monad durum wheat were separated and found to be resistant to some forms of stem rust and to have good agronomic and milling values. The variety was named Kota by L. R. Waldron, of the North Dakota Agricultural Experiment Station, and J. A. Clark, of the United States Department of Agriculture. The commercial production of Kota was begun in 1919. Its acreage was estimated at 471,313 acres in 1924, and its distribution is shown in Figure 13. Since 1924 the acreage of Kota has been reduced, owing largely to its susceptibility to smut. The experiments with Kota, because of its resistance to stem rust, have shown that it is able to yield well under rust conditions. Under favorable conditions Marquis and other varieties of hard spring wheat have outyielded Kota.

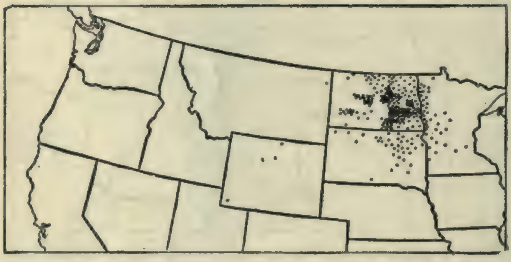

FIGURE 13.—Distribution of Kota wheat in 1924. Each doe represents 1,000 acres or fraction thereof per county. Estimated area, 471,313 acres

Kota is a good milling and bread-making wheat. It has a high percentage of protein and high flour yield and is superior to other varieties in water absorption.

The acreage of Kota should be replaced with Ceres, which was developed from it by breeding. Ceres has all of the advantages of Kota and consistently outyields it.

CERES

Ceres was developed at the North Dakota Agricultural Experiment Station by L. R. Waldron, from a hybrid between Marquis and Kota, made in 1918. The superior characters of Ceres (fig. 14, A) are resistance to stem rust, early maturity, good strength of straw, high yield, and quality. The disadvantages are its susceptibility to both bunt, or stinking smut, and loose smut. Ceres has been grown in experiments since 1923 and commercially since 1926. Approximately a half million acres of the variety were grown in 1929. It is best adapted to the eastern Dakotas and Minnesota, where stem rust occurs. It gives promise, however, of being more widely adapted than any variety developed since Marquis. In field experiments it has consistently outyielded Marquis in all sections of the spring-wheat area of the United States. This increased yield obtained from Ceres also has been accompanied by an increase in quality. In milling and baking experiments Ceres exceeds or equals Marquis in test weight

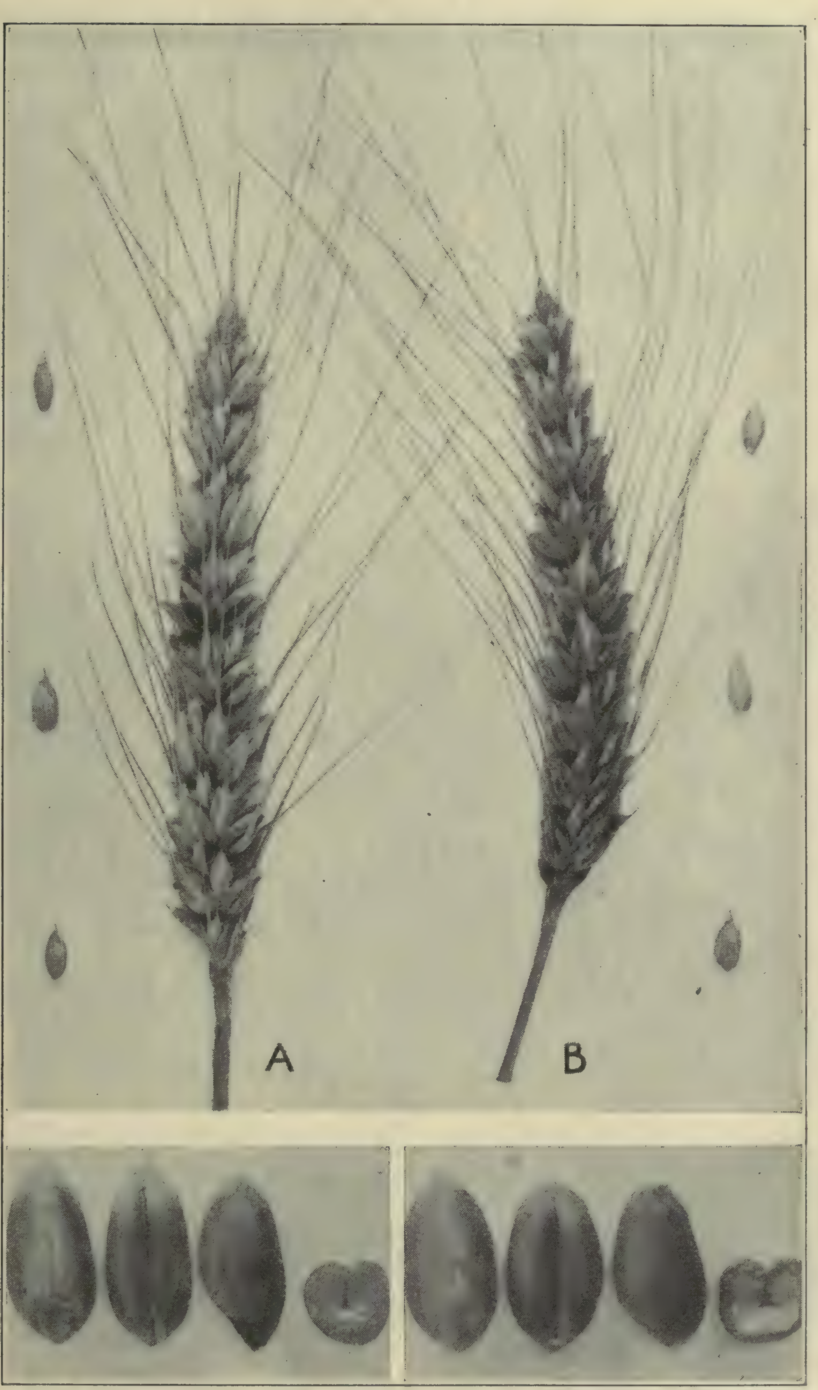

FIGURE 14.—Heads, chaff, and kernels of Ceres (A) and Reliance (B) wheats. Heads and chaff, natural size; kernels, magnified 3 diameters

per bushel, crude-protein content, flour yield, water absorption, volume of loaf, and texture and color of crumb.

The rapid increase in the commercial growing of Ceres wheat appears justified from experimental results. It is now grown in preference to Kota, Ruby, and Preston, and is replacing Marquis and varieties of durum wheat in certain sections.

RELIANCE

Reliance (fig. 14, B) was developed by the Office of Cereal Crops and Diseases, Bureau of Plant Industry, in cooperation with the Oregon, Montana, North Dakota, and Minnesota experiment stations. It is the result of a Kanred × Marquis cross made in 1917 at the Sherman County Branch Station, Moro, Oreg. The superior characters of Reliance are plant vigor, a seedling resistance to certain forms of stem rust, strong straw, and a capacity for high yields under favorable conditions. Reliance is not resistant to stem rust in the mature plant stage and therefore is not adapted for growing in the rust area. In experiments in western North Dakota and Montana, however, where stem rust has not been an important factor, Reliance has outyielded Marquis, Ceres, and Supreme.

Reliance has been grown in plot experiments at stations in Montana, North Dakota, and Minnesota since 1924 and was distributed for commercial growing from the Northern Great Plains Field Station, Mandan, N. Dak., in 1926. Because of its susceptibility to stem rust it has not been successfully grown in eastern North Dakota and South Dakota where it was first distributed. In western North Dakota and Montana, however, it gives promise of becoming a variety desired for "combining." There is a growing demand for an awned wheat for combining by the windrow method, as the awns facilitate a clean pick-up. The stronger straw, larger yields, and later maturity of Reliance may cause it to be preferred to Ceres as an awned variety. The later maturity is beneficial only in extending the harvesting period, as the growing of two or more varieties differing in time of maturity is being practiced for combining by some growers.

In milling and baking experiments Reliance has been equal or superior to Marquis in all important characters and differs little from Ceres except in having a slightly lower protein content.

HOPE

Hope was developed by E. S. McFadden, at Webster, S. Dak., from a selection made in 1923 from a cross of Yaroslav emmer and Marquis wheat made in 1915. The advantages of Hope wheat are its immunity in the mature plant stage from the forms of black-stem rust present in the spring-wheat area of the United States, its resistance to leaf rust, and to both the bunt or stinking smut and the loose smut of wheat. It also is resistant to shattering and to drought. It is susceptible to the black-chaff disease, however, the seriousness of which is as yet little known.

Hope wheat (fig. 15, A) has been in experiments since 1927, in which year it also was distributed for commercial growing. It has

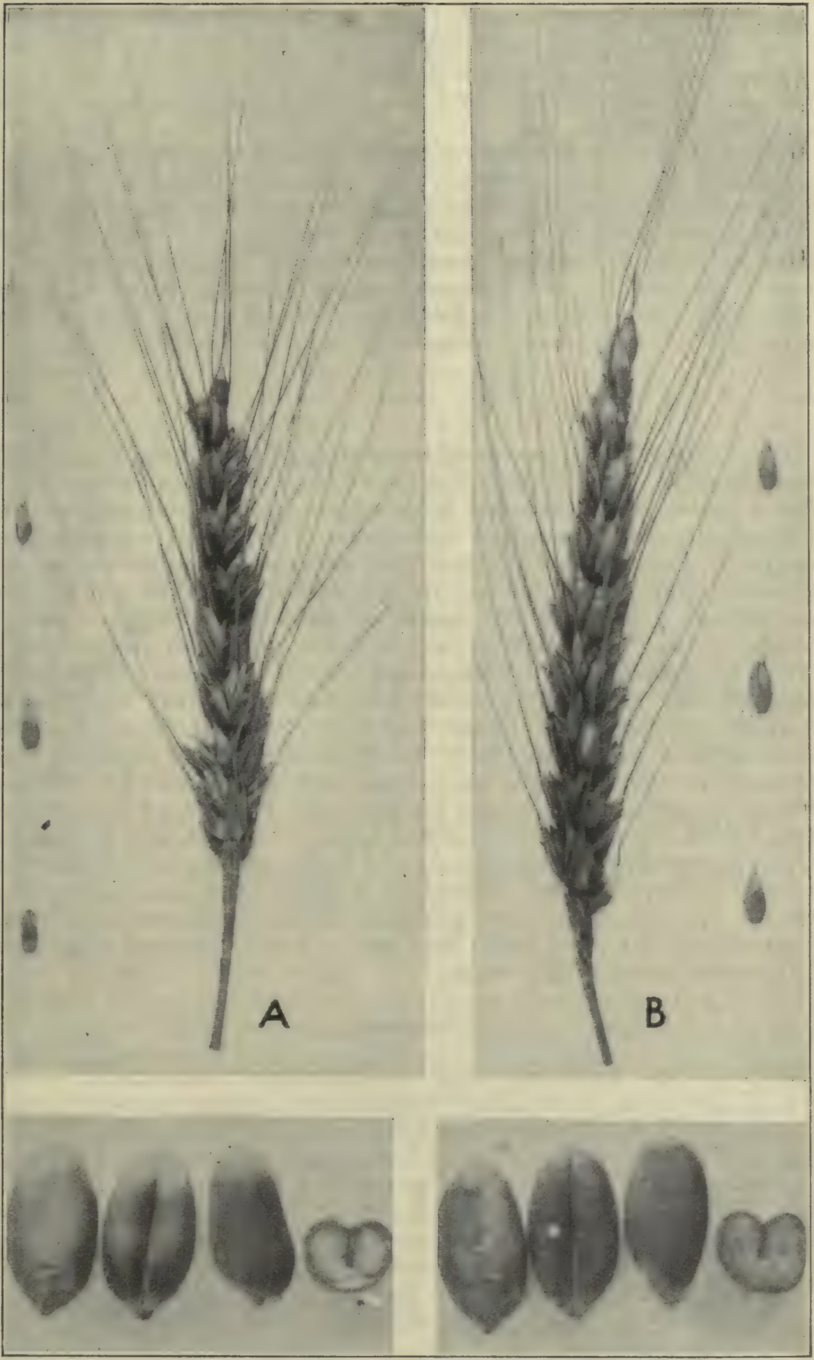

FIGURE 15.—Heads, chaff, and kernels of Hope (A) and Progress (B) wheats. Heads and chaff, natural size; kernels, magnified 3 diameters

yielded more than Marquis but less than Ceres in limited experiments in North Dakota. It appears to be best adapted to the rust area of North Dakota and South Dakota and to unfavorable conditions of drought. It does not have the capacity for large yields under favorable conditions and has yielded considerably less than Marquis in Montana.

In limited milling and baking experiments Hope differs from Marquis in having a comparatively low test weight per bushel but a high protein content and flour yield. Its yield of bran and shorts is low, which contributes to its high flour yield in spite of a low bushel weight. The water absorption, volume, and weight of loaf of Hope is higher, but its color and texture of loaf is lower than that of Marquis. Altogether, the first experimental results indicate that the quality of Hope should be satisfactory.

JAVA

Java (Early Java, known also as Black Tea, China Tea, Early Iowa, Siberian, Swedish, and Tea Leaf) is a mixture of several kinds. Within this variety are found both white and brown chaff, soft and hard kernels, and other minor variations. The heads are bearded and usually have white chaff and semihard kernels. As a rule the kernels are softer than those of Preston. Java is a few days earlier than that variety. Most of the heads of Java have longer "beaks" (points on the outer chaff of each spikelet, or mesh) than Preston.

Java is probably one of the oldest spring varieties grown in the United States. Siberian (a variety identical with Java) was reported grown as early as 1837. China Tea (identical with Java) has been grown in New York since 1845. Early Java was first reported from Nebraska in 1899. It was advertised and distributed in 1900 and later as an early spring wheat by Wallaces' Farmer, of Des Moines, Iowa. Java is grown principally in Iowa, Nebraska, and Wisconsin.

Java has given fair yields in central Iowa and northern Wisconsin, owing to its earliness, which enables it partly to escape rust and hot weather. One strain of Java grown in Nebraska, known as Kearney County Java, is a week to 10 days earlier than Progress, a selection of Java developed in Wisconsin.

PROGRESS

Progress was developed from a selection of Java made in 1916 by E. J. Delwiche at the Marshfield branch station operated by the department of agronomy of the University of Wisconsin. Progress (fig. 15, B) differs from Java in being resistant to stem rust, and it is a better yielder. It has been grown in experiments in Wisconsin since 1917 and commercially since 1921. It outyields Marquis and other spring wheats under Wisconsin conditions but has not shown to as good advantage in other sections. Progress has a high percentage of protein, but usually produces a low volume of loaf in bread-making experiments, indicating that the quality of its gluten is poor. It therefore should not be grown in sections other than Wisconsin, where it is best adapted.

Group 4.—HEADS BEARDED; CHAFF SMOOTH, BROWN OR RED

Only one variety of Group 4, Ladoga, is commercially grown in the United States. The Huron, Laramie, Norka, and Webster varieties are no longer grown commercially.

LADOGA

Ladoga (known also as Spring Turkey and Bastard) as commercially grown contains mixtures of several forms. In general Ladoga is slightly earlier than Preston and is susceptible to stem rust. The kernel of Ladoga, although somewhat smaller, resembles that of Turkey, a hard red winter wheat. Ladoga, also being bearded like Turkey, is sometimes known as Spring Turkey.

Ladoga wheat was introduced into Canada about 1888 from Russia, where it was grown in latitude 60°, near Lake Ladoga, north of Leningrad. Because of its earliness it was distributed by the Canadian Department of Agriculture in northwestern Canada during the next five years, but by 1893 it had been found to be of poor milling quality, and its further production was discouraged. It is not known when or by whom this variety was introduced into the United States, but it is sparingly grown on both dry and irrigated lands, principally in Colorado and Montana. It is not an important variety in any State, but is common in mixture with Marquis.

The yields from Ladoga in comparative experiments have been lower than those from nearly all other varieties of hard red spring wheat. It was early discovered that Ladoga was inferior to Red Fife in milling and baking qualities. This wheat, therefore, should be entirely replaced by other varieties.

Group 5.—HEADS BEARDED; CHAFF VELVETY, WHITE OR YELLOW

Group 5 includes two rather unimportant varieties which differ widely in characters and in adaptation.

PRELUDE

Prelude (Wisconsin Wonder) is extremely early, maturing from 7 to 10 days earlier than Marquis; it has short stems, heads, and kernels. The beards also are short and dark brown or black when ripe, and the chaff is covered with short fine white hairs. (Fig. 16, A.) The heads shatter very easily when fully ripe, so the variety must be harvested while still somewhat green. The kernels of Prelude are of a dark-red color and have a very short brush.

Prelude was originated by Charles E. Saunders, cerealist of the Dominion Department of Agriculture, at the Central Experimental Farm, Ottawa, Canada. It resulted from a cross made in 1903 between the Fraser and Gehun varieties. Fraser also was of hybrid origin and was produced at Ottawa, whereas Gehun was introduced from India. Prelude was first distributed in Canada in 1913. It was introduced into the United States by the United States Department of Agriculture for experimental purposes in 1915. About 1910

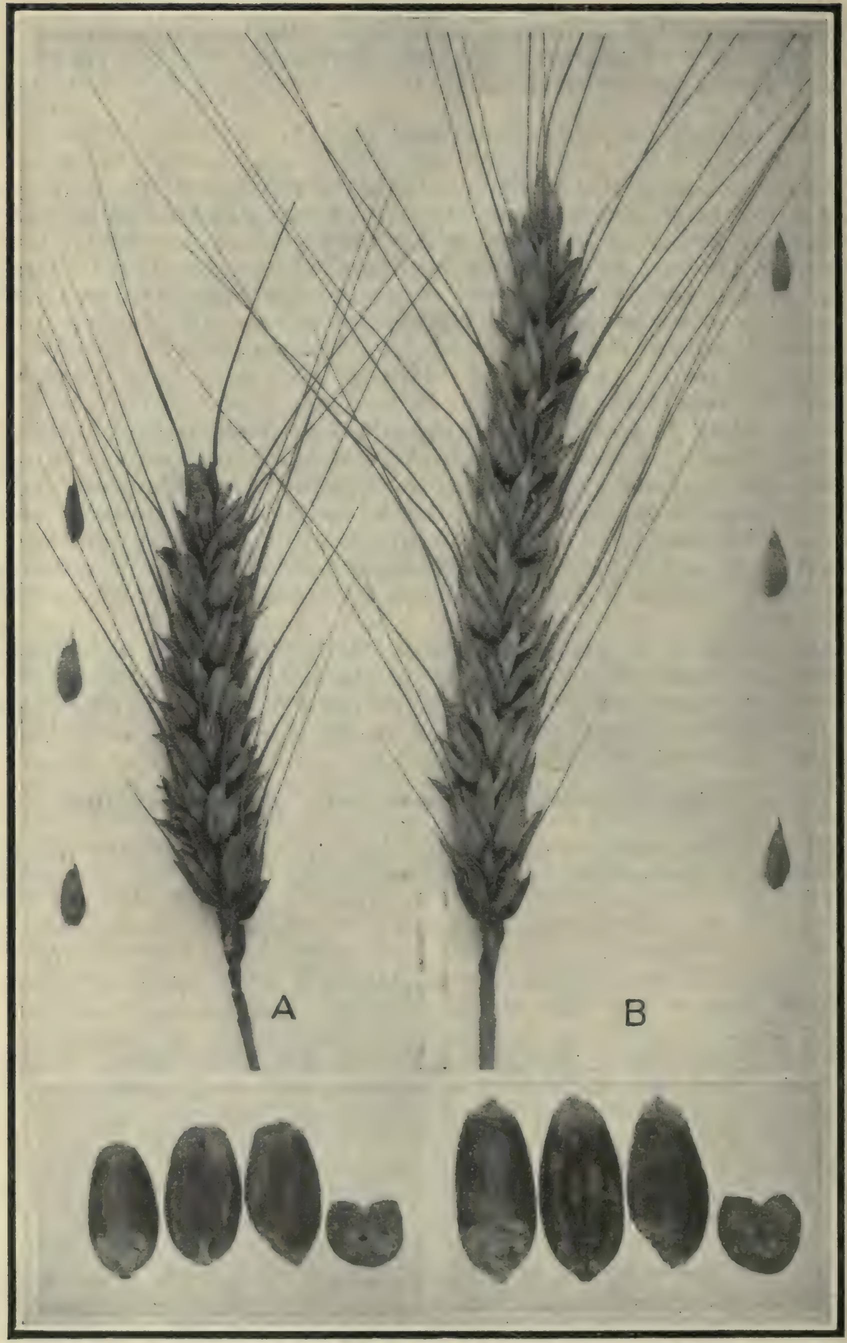

FIGURE 16.—Heads, chaff, and kernels of Prelude (A) and Humpback (B) wheats. Heads and chaff, natural size; kernels, magnified 3 diameters

H. E. Krueger, of Beaver Dam, Wis., found a plant of Prelude in a field of Marquis. This he increased and distributed as Wisconsin Wonder, and Prelude now is grown to a limited extent under that name in Wisconsin and Minnesota.

Prelude is best adapted to the northern wheat sections of Canada, for which it was originated because of the very short growing season; but in the United States it is too early to produce maximum yields. Under favorable conditions this wheat usually is outyielded from 10 to 30 per cent by Marquis or other varieties. Its earliness sometimes has enabled it to escape summer drought or hot winds and give fairly good yields in seasons which were very unfavorable for later-maturing varieties. In a few dry seasons, in the Great Plains section of Colorado and Nebraska, Prelude has outyielded all other hard red spring wheat varieties. On the average, however, even in these sections, Prelude is outyielded by Marquis and several other varieties. These sections also are better adapted to hard winter and durum spring wheats than to hard red spring varieties. Prelude is not now and should not become an important spring wheat in the United States, on account of its low average yield, its susceptibility to smut, and its easy shattering. Prelude is equal or superior to Marquis in milling and baking qualities, and this high quality has been transmitted to Reward, which is a much more promising variety.

HUMPBACK

Humpback (known also as Bearded Bluestem and World Beater) has bearded, velvety, white-chaffed heads like Prelude, but the heads are long and wide and the plant is late in maturing. (Fig. 16, B.) The kernels are softer than those of most of the hard red spring varieties and are large and pale red, with a long and large brush and a shape commonly described as humped. The crease of the grain has a deep pit or opening in the middle.

Humpback originated from field selections made by J. P. Berglund, a farmer living near Kensington, Minn. The original head probably was the result of a natural field hybrid. Two strains were developed. The first, which was distributed about 1905, became known as Humpback, and the second, which was distributed a few years later but which differs in having smooth chaff, as Dixon. Humpback is not grown so extensively now as it was a few years ago.

In all comparative experiments Humpback has given low yields. It matures too late to avoid rust and drought and is not a high-yielding wheat under favorable conditions. It also has inferior milling and baking qualities, and because of this it brings a low price on the market. The growing of Humpback, therefore, should be discontinued.

ADDITIONAL VARIETIES

There are several other distinct hard red spring varieties commercially grown which have not been extensively tested at experiment stations or registered on the basis of their performance. Very little is known, therefore, regarding these varieties, and none of them are recommended for extensive growing. Principal among these are Sea Island, Montana King, Early Triumph, Renfrew, Marvel, Whitman, and Vermillion.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

May 1, 1930

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RURAL BUILDINGS FOR BUSINESS AND SOCIAL USES

By WAYNE C. NASON, *Assistant Agricultural Economist, Division of Farm Population and Rural Life, Bureau of Agricultural Economics*

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INTRODUCTION

A TYPE of dual-purpose building is appearing in rural communities which fulfills more functions, houses more activities and centralizes the varied economic and social interests of the community more effectively than does the ordinary community building. The construction of such buildings tends both to enlarge communities and to make them more compact.

When such buildings are erected primarily for economic purposes, provision is made therein for community social activities and interests in order to supplement and strengthen economic factors. If community social advancement is the main object of the building, provision is made for economic interests so that the community may be served in a comprehensive way.

The construction of this type of building is being stimulated by the increasing number of farmers' business organizations, the efforts of extension forces in promoting the business activities of farm women, the growing conception that community interests are not limited to social activities, and the community advantage gained by the focalization of its attention upon related activities and common problems.

Farmers are not only marketing farm commodities and purchasing farm supplies through their associations but are employing the cooperative idea for community improvement along social lines. They are associating to build rural electric, power, and telephone lines; to establish markets, laundries, and fire departments; to form irrigation, drainage, flood-protection, road, and fence districts; and to form calf clubs and bull associations. In other instances they associate to obtain chautauquas, community buildings, rest rooms, parks, playgrounds, bathhouses, public monuments and reservations, orchestras, bands, athletic teams, social clubs, and adult education classes.

Farm business organizations are establishing social bureaus in their organizations and are appointing social workers to develop among the members these social factors necessary for success. Community centers among the local units are formed to increase the knowledge and spirit of cooperation. Clinics are established; contributions are made for local fairs, sanitary campaigns, the securing of rural nurses, and for needy schools; picnics, entertainments, and games are promoted.

The type of building now being adopted, which is well located, adequate as to size, with convenient arrangements and facilities, not only adds to the efficiency of operation, but gives the idea of permanency and pride of ownership, and, through its social activities, promotes harmony and education.

Organizations are giving a great deal of attention to the planning of this building, so that each part will most economically and efficiently promote the work as a whole. Good architecture and convenient and attractive arrangements are receiving increasing attention. In the arrangements and facilities of many of the most successful farm business buildings, the attention centered on the economic side is little greater than that centered on the social side.

EXAMPLES OF RURAL COOPERATIVE BUILDINGS

This newer type of building has various modifications. On the basis of their general economic uses the buildings may be classified as farm economic, home economic, and farm and home economic. These three classes of buildings include various modifications based on their specific purposes and the activities carried on in them.

FARM ECONOMIC BUILDINGS

A number of the buildings studied as a basis for this bulletin were promoted by organizations the economic aims of which pertain largely to the farm rather than to the farm home. The organizations are of a farm-business nature and are almost, if not entirely, controlled by men.

Cooperative creamery association buildings compose the largest number. They are found chiefly in Minnesota, where the social influence of the management of the Land O'Lakes Creameries (Inc.), is strong. Many of the cooperatives are members of that organization. The first such building, however, was erected at Fergus Falls, it is believed, prior to the formation of Land O'Lakes Creameries (Inc.). This was followed by similar buildings at Springfield, Barnesville, Mora, Frazee, Wadena, Pelican Rapids, Belleplaine, and other places.

Cooperative cheese buildings center largely in Wisconsin. Fruit growers' buildings center in Florida and to some extent in California. One of the first farmers' marketing organizations to erect a permanent building with social features was the Eastern Shore of Virginia Produce Exchange of Olney, which serves the farmers of several counties of Virginia and Maryland.

All of these buildings provided assembly halls, kitchens, and rest rooms to serve the social interest of the whole family. These economic organizations frequently have subsidiary social organizations. In the Franklin Cooperative Creamery Association, Minneapolis, Minn., which distributes milk purchased from the Twin City Milk Producers' Association, the social interest of the organization are expressed through four societies totaling 50 members.

COOPERATIVE CREAMERY

The Farmers' Cooperative Creamery of Mora, Minn., is a democratic organization of farmers centering about a country town of 1,006 people in a county of 9,086 population. The total resources of the company on January 1, 1928, amounted to $142,677.03.

The farmers' income from butterfat manufactured in 1919 brought $134,448.50 and in 1927, $339,692.84. The value of total annual business transacted increased from $146,895 in 1919 to $603,693 in 1928.

Notes payable in 1927 amounted to $26,000; bonded indebtedness, to $10,000; capital stock, to $13,250. Permanent improvements came to $89,502.71. Surplus was more than five times the outstanding capital stock. The average price received for butter per pound by the cooperative was 45.07 cents; the average price paid to farmers for No. 1 butterfat per pound was 51.54 cents.

There are three main departments—the creamery, the feed department, and a department that deals with such products as poultry, eggs, and hides. The plant consists of four principal buildings in town and a small exhibits building on the fairgrounds. (Fig. 1.)

In the feed department the company buys and sells grain feed, seed, cream cans, poultry supplies, remedies, and flour, not only to members but to others; these are sold on a basis of 10 per cent over cost. It grinds feed in its mill, mixes feed, sells fruit, cracks and grades corn, and hulls oats. The cooperative is a member of the Land O'Lakes Creameries (Inc.). It won the championship of the State for workmanship and efficiency in butter making.

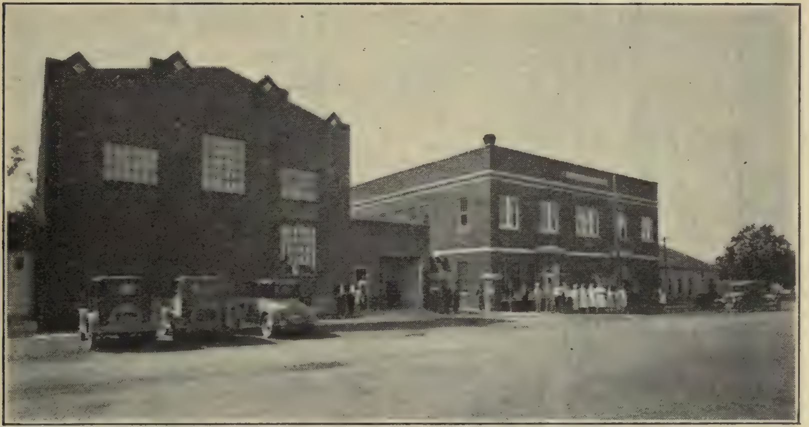


FIGURE 1.—Farmers' Cooperative Creamery, and its employees, Mora, Minn. The assembly hall is on the second floor in the large building at the right and the women's rest room is in the lower left corner

Its far-seeing leaders have not depended entirely upon operating on correct economic principles. Social interests have been closely correlated with the economic interests from the beginning of the enterprise. The institution is known as "our company." It is the headquarters of the farmer and his family when in town. Its democratic control prompts him to study the economic principles necessary to its success. More than a thousand stockholders and patrons attend the annual meeting and picnic held at a near-by lake.

In planning the present creamery building in 1922 these farmers and their leaders recognized the interdependence of economic and social factors. A comfortably furnished rest room was provided on the front-left corner of the creamery building, on the ground floor and easy of access. Here an average of 20 farmers' wives and their children daily rest from shopping or await the termination of the men's business at the creamery. The second story of the creamery building was built as an auditorium and kitchen.

The creamery building is of pressed brick and is 70 by 72 feet. (Figs. 2 and 3.) The auditorium is 48 by 60 feet and has a concrete floor and a large, well-equipped stage. Seats are provided for 450 people, and there is a piano. The kitchen is equipped with water, an electric stove, and dishes to serve 250 people. An anteroom, a committee room, and cloakrooms are on this floor. The building is so constructed that people in the auditorium are not annoyed by the operation of the creamery below. This second floor of the building is a real community center extensively used by farmers and townspeople alike.

The management holds tuberculosis clinics in the auditorium under the direction of a doctor from the State public health service and a local nurse. Better homes week is celebrated. Among the organizations that hold meetings in the building are the Guernsey breeders' association, the Holstein breeders' association, the cow-testing association, the commercial club, the American Legion and its woman's auxiliary, the Modern Woodmen, the Mora town band, several church societies, the directors of the cooperative, and the stockholders.

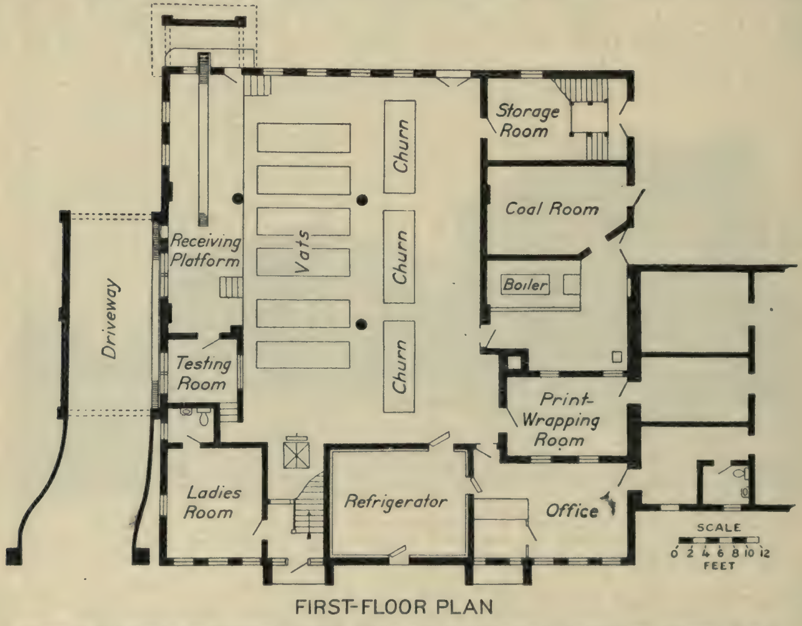


FIGURE 2.—First-floor plan of the Farmers' Cooperative Creamery, Mora, Minn.

Once a year there is a meeting of the members of the cooperative. Fourteen hundred people were served luncheon at the 1927 meeting. Banquets are held by the butter makers of district No. 2 (six counties), the bankers, and the Izaak Walton League. Religious meetings are frequent, as are church suppers. There is an annual county poultry show. The auditorium is open for lectures, local plays, and entertainments of all kinds. The company encourages the use of the hall for all public purposes, and township elections are held here.

The original cost of the creamery building and equipment was $42,901.36, itemized as follows: Building contractors, $29,407.95; drilling well, $354.38; sewer connections, $81.22; plumbing, $4,150; refrigerating plant, $3,075.47; automatic scale, $425; pump, $855; electric wiring and motors, $1,157.66; piping equipment, $1,938.68; vault door, $150; architect, $1,366.

Creamery machinery to the value of $10,028.48 was later installed. The equipment in the auditorium is valued at $613.76.

The cost of the building, $42,901.36, was financed largely by issuing bonds, the principal on which was to be retired gradually by a 2-cent per pound deduction on all butterfat purchased from the farmers. This deduction was later reduced to 1 cent per pound. A debt of $10,000 remains to be paid, but could be cared for at any time if necessary. The village gives $6 a month toward the maintenance of the rest room.

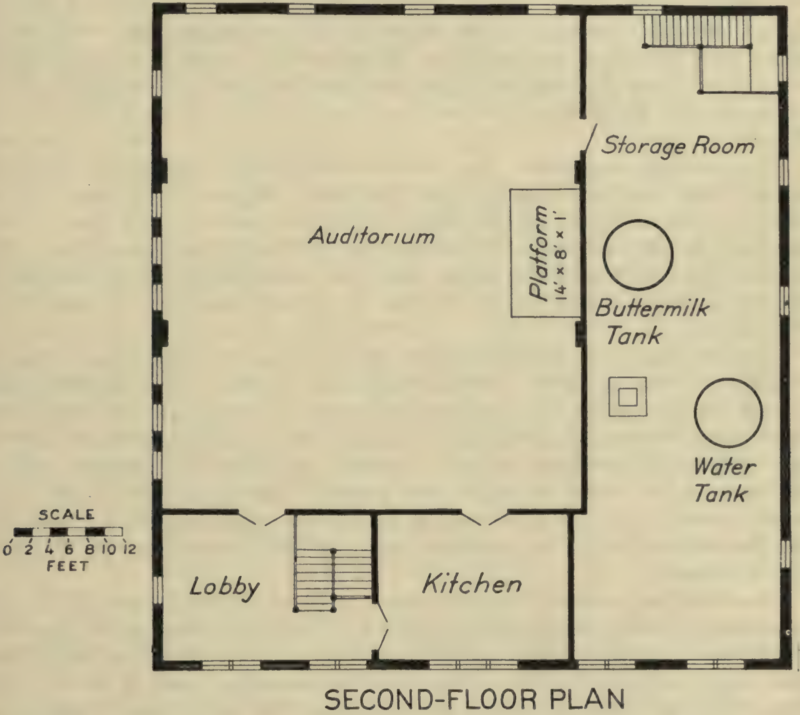


FIGURE 3.—Second-floor plan of the Farmers' Cooperative Creamery, Mora, Minn.

The cooperative is controlled by a board of nine directors, three elected annually by the stockholders. The directors elect their own officers. There were 343 stockholders and 443 patrons in 1928.

This building is the center of the economic and social life of the whole community. Business men of the town and farmers meet here; thus the business men become interested in the success of the farmers' enterprise, and farmers become interested in the problems of their trading center.

Officials of the company and farming and town people express complete approval of the results. The innovation of having the social center above the creamery was a complete success. One company official believes they could scarcely get along without their social center. The building is considered satisfactory in every way.

This cooperative creamery company was not successful in its early years, having become disorganized on account of factionalism. A local minister is given credit for having gone among the members of the organization, composed largely of Swedes, Norwegians, Danes, and Americans, consulting all factions, promoting accord, and welding together a harmonious, successful organization.

CHEESE-STORAGE BUILDING

Clark County, Wis., was settled comparatively recently, but it is one of the first counties in the State in cheese production. The Central Clark County Cooperative Storage Co. erected a building at Greenwood for the cold storage of cheese which is brought in from a number of small factories in the county. The farthest factory is 18 miles away.

The storage company was incorporated May 11, 1925, and the storage building is leased to the National Cheese Federation, Cooperative, a state-wide organization that markets cheese for several hundred local factories. Previous to the organization of this federation the output of the local factories was marketed individually. About 2,200,000 pounds of cheese is stored annually in the local warehouse.

The promoters of the building considered that more than a simple warehouse was needed. Something was required that would make it possible to bring the farmers together in a social way and thus strengthen their morale and heighten their loyalty to the local organization. Therefore, it was decided to include a public hall, a kitchen, and a farm women's rest room. The manager of the company stated that since it was a farmer's organization he thought the farmers should have some place in the town that they could call a home.

The building, erected in 1927, was built around a former flour mill containing many large pine timbers. The mill was partially torn down, then reconstructed, and an addition was placed at each end. The main part of the building is of two stories and is 36 by 40½ feet. The additions are one story high; the front one is 36 by 32 feet, and the rear one is 36 by 40 feet.

Except for the rest room, the first floor is given over entirely to the business of the enterprise. The rest room is near the front, is 12 by 12 feet, and is connected with toilet. It is furnished with couch, tables, and easy chairs and is heated by steam. The remainder of the first floor is given over to a well-equipped office, a wash room 40 by 36 feet, a cold-storage room 36 by 40 feet, a supply room, and a storeroom.

The second floor contains the assembly room (41 by 36 feet), a well-equipped kitchen, and a storage room. The assembly hall has a raised platform, a hardwood floor, seats for 200 people, and an organ.

In the basement is the ammonia plant and boiler, another cold-storage room, and a coal room. Steam heat and electric lights add to the comfort and efficiency of the building.

For the old building $5,600 was paid. Expenses of reconstruction amounted to $9,583.03 and machinery $4,200, making the total cost of the building $19,383.03. The cost of finishing the assembly hall was $350. Voluntary labor contributed considerable work.

The storage company was incorporated for $20,000 at $50 per share. Shares to the value of $12,000 were sold in 10 days. As enough shares were sold at once to pay for the contemplated building, a loan of $7,100 was made, after $12,900 had been realized from the sale of shares. The company is confident that it can repay the loan in a number of years from the receipts from rentals, entertainments, and dances.

The company received $2,200 rental from the national federation in 1927 for storage use. This covers all overhead expenses and a 6 per cent dividend on the share capital of the storage company.

In 1927 the storage company had 222 shareholders, of whom 200 were farmers. The company is governed by a board of five directors, elected annually by the shareholders. The board elects from among themselves the usual officers.

When the building had been in use only six months, including one winter, it was rapidly becoming the farmers' community home. The county agent had used the assembly hall for several county meetings, and the county calf club was meeting there. It is the meeting place of the Society of Equity, the farmers' store company, the American Legion, the stockholders of the company and the company directors, and of general farm assemblies. A number of dances have been given by the building committee, the profits of which have furnished the kitchen and rest room. From the first dance $90 was cleared after purchasing two oil stoves and dishes to serve 200 people.

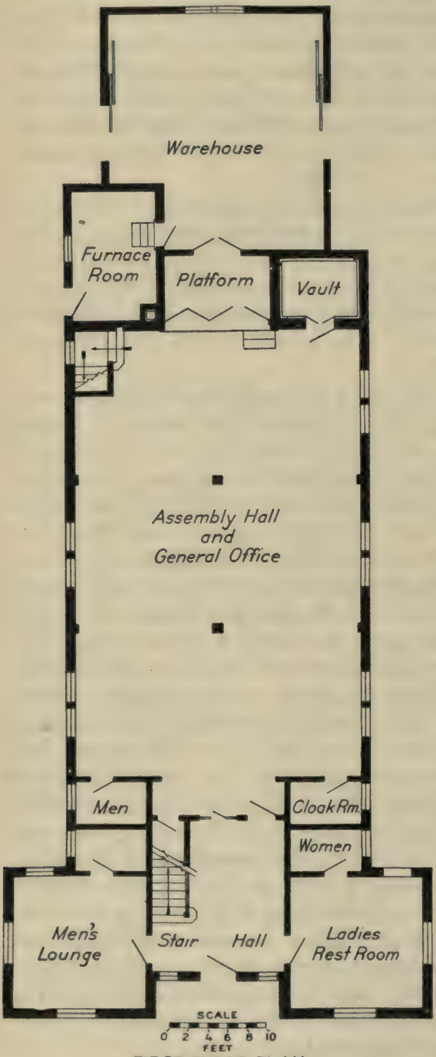
The stockholders of the storage company are well satisfied with their building and with their efforts to form a community center that would bring their economic and social interests into mutual cooperation. Reconstructing the building had its difficulties, but they were in immediate need of a new building, the people were in an approving mood, and at that time, late fall, they could not well have built new foundations. The manager of the company expressed his strong approval of the idea that the members of the company should mix business with pleasure. He believes that women play a greater part in our economic affairs than is generally realized and that when they are thus given a chance to make effective use of their interest the results greatly benefit the company, especially in sustaining the morale of its members. He believes that many people who are not members come to the social meetings in the building and become interested in the business of the company.

POTATO GROWERS' ASSOCIATION BUILDING

The Hastings Potato Growers' Association, Hastings, Fla., is a nonstock, nonprofit, farmer owned and controlled business cooperative operating about a town of 761 population.

It was organized in the fall of 1922 by a small group of farmers, many of whom had been members of a large cooperative that had ceased to exist. In organizing the new company special attention was given to the ideas of democracy of organization and the appeal of social interest.

The total assets of the company on June 30, 1927, were $213,534.57, over one-half of which is represented by income-yielding investments, stocks, and bonds. Buildings and equipment used for the operation of the business are valued at $39,546.08. There are no liabilities other than those to members represented chiefly by the reserve fund. Up to June 30, 1927, the reserves refunded to members in cash amounted to $78,875.



FIRST-FLOOR PLAN

FIGURE 4.—First-floor plan of the Hastings Potato Growers' Association Building

The association began its work in two small rooms and later moved to a larger room. The business increased to such an extent that a building especially planned and owned by the association seemed to be needed. Moreover, the manager and directors felt that a building conceived as "the economic and social home of this group of farmers," in which each farmer had a share, would promote the loyalty of the members, typify the group idea upon which the organization was based, conserve its democratic ideals, and enlist the interest of the wives of the members in the business. The lack of interest among the wives of members, through ignorance of the aims and workings of the organization, had seemed to be one of the causes of the failure of many farmers' business cooperatives.

The building was planned by an architect, but embodied the ideas of the manager of the association. A plot of ground was selected on the boulevard less than one-half block from the railway.

The building, dedicated in March, 1927, is two stories high, is of hollow interlocking tile construction, stucco with stone trimmings on the outside, and hardwood and plaster in the interior. (See cover picture.) It is 45 feet across the front, narrowing 16 feet back to 32 feet, and later to 24 feet; the lower floor length is 107½ feet. It was designed primarily for business use but was so planned that it could be readily adapted to social uses other than those provided for in the original architect's draft.

At the lower right front is a women's writing and rest room, 16 by 16 feet, and at the left is a lounging room of similar dimensions for men. Back of each are toilets and cloakrooms with tiled floors, each about 5 by 8½ feet in size. The entrance hall, 14½ feet wide, which separates these rooms, has a stairway leading to the second floor. At the rear the hall leads to the large central office room, 50 by 32 feet, where are housed the accounting and field forces. (Figs. 4 and 5.)

At the rear center of this office room is a stage about 10 by 12 feet in size, at the sides of which are the heating and water plants and a 2-story vault. This large office room and stage were designed with a view to making it possible to clear the office room readily and turn it into an auditorium with a seating capacity of 300 people. This can be done in half an hour by three men. A stairway leads from this office to the second floor. Back of this office is a storage warehouse, 25 by 24 feet, with a covered loading platform extending along the right side.

The manager's office was originally placed on the second floor, above the women's rest room, with the stenographer's office in the rear. Later, to obtain more privacy, a room in the rear near the vault was partitioned off for his use, and his original office became a reception room. At the left, above the men's lounging room, is the directors' room, with toilet and cloak rooms. The remainder of the upper floor is occupied by the traffic and field forces. The building is provided with a private leased telegraph system and with extension and outside telephones. The organization has its own artesian well, and in the building is its water-softening plant from which water is carried through the entire building. On the premises is the company garage, 32 by 36 feet, of the same material as the office building.

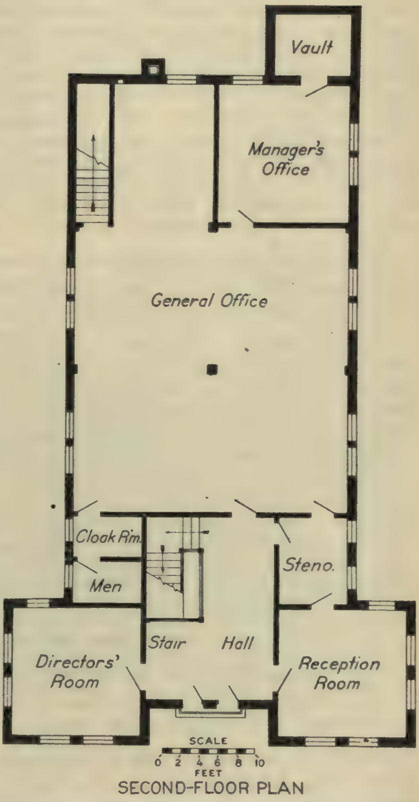


FIGURE 5.—Second-floor plan of the Hastings Potato Growers' Association Building

The building is attractive, and the grounds are well kept. The cost of the building was $28,900; that of the equipment, $4,000; and that of the grounds, $6,000. There were two cottages on the 2 acres of ground purchased, from which $25 per month rental is received.

The building was financed from money in the reserve fund. At the end of 1928 about one-half of the cost of the building had been paid back to the reserve fund, and it is expected that all will be repaid by the end of the fifth year.

The policies of the association and of the building are formulated by a board of nine directors.

After one and a half year's use the organization evaluated the physical aspects of the building as follows:

(1) General arrangement: The placing of the various departments is convenient and consequently business friction and loss of time are reduced, and the morale of the working force is increased. People may come in to see the manager without interruption of other business . The inside telephone exchange, with the operator available to receive visitors, facilitates this. (2) The women's rest room: The wives of members come to town and use this room through right of ownership. At the same time they become acquainted with the business of the organization and its officials and employees. (3) The men's lounging room: Similarly, the farmers use this room. They feel free to come in and talk among themselves. (4) The convertible assembly hall: The building is not a community house, but a business-organization building. Thus, the social uses of the hall are not extensive, but it is possible to have a large hall quickly available for the various general meetings of the association and for special uses when needed. This arrangement of the building also results in a considerable financial saving.

Efforts of the management to evolve an organization and erect a building that would be economically efficient and conducive to the social welfare of the members were evaluated as follows:

(1) The wives of members are made to feel an interest in the building, and thus in the organization itself. Through use of the building they come to understand the workings of the organization and its worth and to take a sympathetic interest in its purposes and difficulties. Since the home maker is an important element in the success of the farmer, and since her success in home making depends greatly on the husband's financial success (and on her handling of the family purse) it is only the part of wisdom that both partners have an understanding and appreciation of the means of financial success. (2) Financial ownership in the building stimulates the interest of the grower's family in the success of the association. Members bring their friends to see the building they own. (3) Ownership in the building promotes that democracy of organization and social welfare of members upon which the management depends so largely for its business success.

GROWERS' ASSOCIATION BUILDING

Plant City, a town of 3,729 population, is in the eastern part of Hillsborough County, in the fruit and vegetable section of Florida. The Plant City Growers' Association was organized in 1916. It is engaged in the retail mercantile business, and aims to handle everything the farmer needs in his business, including groceries, meat, feeds, farming implements, fertilizers, insecticides, and crates for fruits and vegetables.

From a business point of view the organization is not strictly a cooperative. It is incorporated, and in May, 1928, had 170 stockholders, of whom 140 were farmers or producers. Some stock is held by local business men.

In 1921 the association erected a building for its business. Recognizing the advantages of relating the social activities of its members to their economic interests, it included in the floor plans of the building provision for an assembly hall for the use of its members and others, and a rest room. The first-floor plan included some storerooms for rental purposes to other business concerns, and the second-floor plan made similar provisions for offices.

Practically since the opening of the building the county agent and the home demonstration agent have occupied offices in the building, which, with the assembly hall, are centers for much business and social activity.

The building, of brick with stone trimmings, is two stories high and 205 feet square, and gives the impression of being a good, substantial business and office building. It is located in the heart of the city on a corner lot. On account of the warm climate the lower story is protected by a permanent awning around the street fronts. (Fig. 6.)

The front half of the first floor is occupied by the grocery store and meat market of the association and by three business concerns, each of which rents a room from the association. The rear half is one large room given over to the sale of feed, hardware, crates, etc.

The front or west side of the second floor has six rooms designed for rental purposes. The county agents are furnished two of these rooms at actual expense. On the south side are a rental room, the association's produce buyer's office, general office of the association, and the large assembly hall. Back of these offices is a passageway leading to the assembly hall. Nearly all of the northeast part of the building is given over to use as the warehouse of the association.

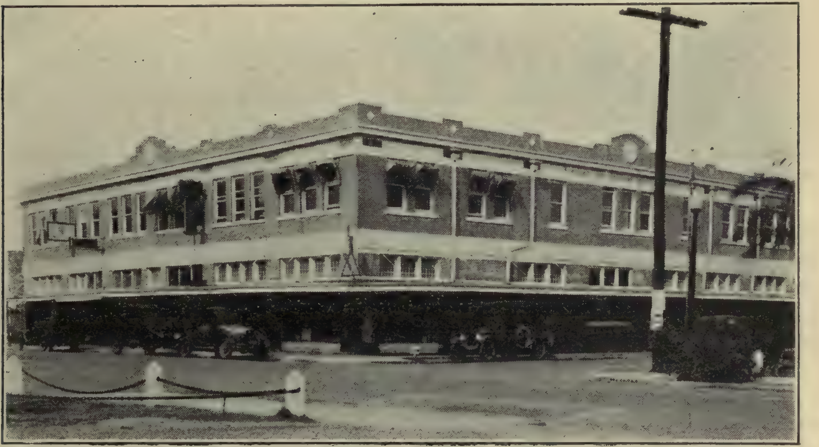


FIGURE 6.—Plant City Growers' Association Building, Plant City, Fla.

At the back of the warehouse, opening on the passageway, are an office supply storeroom, a men's toilet, and a women's rest room. The building has electric lights and is furnished with city water.

The items entering into the cost of the plant were: City lots, $8,000; building, $34,000; store fixtures, $5,964.36; total, $47,964.36.

The building was financed by the sale of stock to members. For the maintenance of the building a rental of $175 per month is received from the outside agencies that occupy rooms. The building is owned by the association, and the building and the business are controlled by a board of directors with the usual officers.

Groups that use the assembly hall are the directors of the association and the stockholders; the Hillsborough Poultry Association; the officers of the Farmers and Merchants Bank; boys' clubs for corn, pig, truck, citrus, calf, and poultry growing; girls' and women's sewing, conservation, poultry, home improvement, flower, gardening, and nutrition clubs. Other meetings of various kinds are held by the farmers and the county agent, accompanied by dinners and other forms of refreshment service and social features.

Not a little of the success of this farmers' association is attributed to their building in which their business and social interests mingle, interests which tend to cement the loyalty of the members to the corporation handling their business.

HOME ECONOMIC BUILDINGS

The women farm home makers in some districts have been active in promoting buildings in which to conduct those common home-business interests that help toward the success of both home and farm. In their home-business buildings they usually make provision for those social interests which make for economic success.

The extension program of the national and State extension forces has been the chief factor in stimulating the mutual home industries of women and girls, causing them to organize and in many instances to erect buildings where they can meet to learn new practices and develop their industries under the binding force of social interest.

Many home demonstration clubs rent quarters in other buildings or use community buildings, but many have built or acquired their own buildings. Notable examples are found at Hope Hull, Smyrna, Selma, and Winterboro, in Alabama; at Ringgold, Bowden Junction, Bolton, and Orchard Knob, in Georgia; at Steel Creek, N. C.; at Union, Miss.; at Lynn Grove, Ky.; at Port Stanley, Wash.; at Pear Valley, Tex.; at Austinville, Va.; at Parma Corners, N. Y.; at the Clothier community, Norman County, Okla.; and at Rancho de Atriscas, Bernalillo County, N. Mex.

In the last place, an open-country community, the women organized the Housekeepers' Canning Club, erected a building, and installed canning equipment, financing everything by receipts from entertainments. Here the women gather to do their extensive canning of vegetables, fruits, and meats in common, and to hold their social events.

HOME BUREAU COMMUNITY HOUSE

The rural women of many communities in New York, as in some other States, are organized into home bureaus. The home bureaus were largely inspired by the State agricultural college and are supplied reference material for their work by the college. They work in cooperation with the farm bureaus and the boys' and girls' clubs. The local groups are branches of the county groups, which, in turn, are federated into a State group. These county women are thus enabled to pool their experiences for mutual benefit.

At the end of 1928 there were 63 members of the West Hempstead home bureau on Long Island, in a district given over largely to truck farming and market gardening. Until 1921 the bureau met in the school auditorium. As this was not always available and as they wanted a place where home demonstrations could be given readily and where large community gatherings could be held conveniently, the club voted to incorporate and build its own club and community house.

The building, erected and owned by the West Hempstead Home Bureau Club (Inc.), was opened for use in February, 1922. The total cost of the plant was $4,823, of which $4,300 was for the original building, $400 for an addition to the kitchen, $75 for chairs, and $48 for tables.

The building was financed by $1,100 from the bureau treasury, which had been gradually accumulated from subscriptions and receipts from entertainments, and by a loan of $3,200, for which a mortgage on the building was given. This loan has since been reduced to $2,500 by means similar to that by which the original $1,100 was accumulated. In 1928 the club had $400 in its treasury.

Considerable voluntary labor was used in the erection and equipment of the building. The lot, 40 by 100 feet, was donated, as were a gas range for the kitchen and some furnishings.

The building is maintained at an expense of about $127 per year, of which $15 is for coal, $12 for lights, $15 for gas, $15 for care of grounds, and $70 for taxes. Money for maintenance expenses and for repaying the loan is obtained through receipts from suppers, plays, and entertainments given in the building.

The title to the building is vested in the Home Bureau Club (Inc.). An elected executive committee of five members, with the usual officers, has charge of the building and of the affairs of the club.

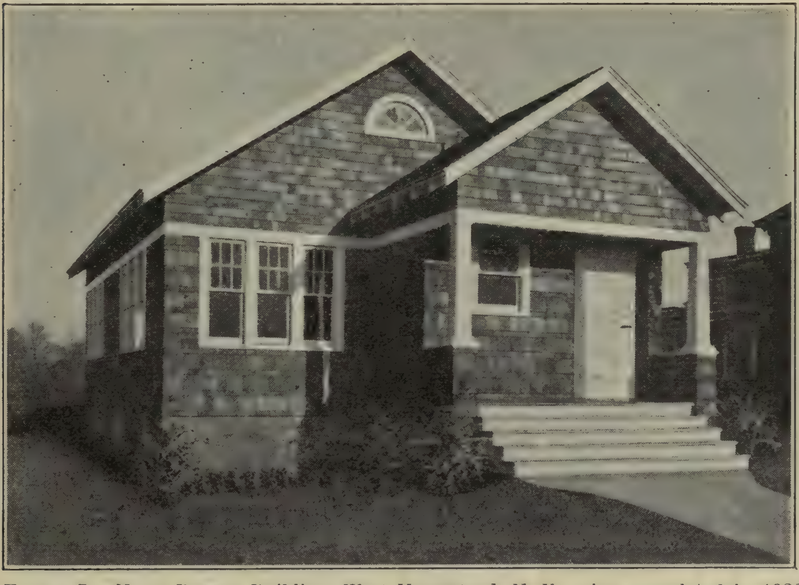


FIGURE 7.—Home Bureau Building, West Hempstead, N. Y., when completed in 1922

The building, 25 by 44 feet, is of one story and has a cellar under the main hall. The hall, 24 by 35 feet, will seat about 125 people and is equipped with chairs, tables, and a piano. At the rear is a kitchen equipped with gas and coal ranges, dishes, and cooking utensils. A 1-pipe furnace provides heat, the lighting system is electric, and water is supplied by a pump in the kitchen. It has a large, substantially built front porch. In recent years the lawn has been seeded to grass and shrubbery planted. (Fig. 7.)

The building is used by the local home bureau for all of its business and social activities. The home demonstration agent uses it for demonstrations and class work in clothing, millinery, foods, canning, nutrition, and other projects, as well as for the social events of the club members. Banquets are held in the large hall. County-wide home bureau meetings often take place here. Every September a community fair is held in the building by the local home unit. A special exhibit of the products of club work, including sewing, food and canned stuffs, vegetables, and flowers, is included in this exhibit and many prizes are received from the fair association. The building is available for other community events. The union Sunday school has used it for several years. Community parties, suppers, and entertainments are frequent.

This home bureau is in suburban territory only 25 miles by rail from New York City. It has perceived from its beginning that the combination of social and economic interests is a key to successful rural-community efforts. In the use of this building each of these influences is used to reinforce the other. Said a club leader:

> The building is satisfactory and adequately serves the community, with the result that we now have community interest and community life in a metropolitan suburban community surrounded by communities with no community interests, life, or center.

HOME DEMONSTRATION CLUB HOUSE

From a suburban community of Long Island to a forest community of Georgia is a considerable change, not only in location and climate but in economic resources. The people of the communities are much the same, however, in their outlook upon life and in their wish to promote and conserve a high standard of country life. In both districts such aims are striven for through cooperatively related economic and social forces.

Beulah is the term applied to an open-country farming community, several miles from Carrollton, Ga. The community is composed of from 100 to 150 farming people, who are rather isolated from the nearest town, Carrollton, because they are almost surrounded by a river and a creek and have inadequate road and bridge facilities. The forest stretches along the river and creek beds. Education is provided in a primary school located on a small tract of land from which the forest was removed.

The home demonstration girls' club was organized in the old 1-room school in 1918 with six girls as members. The community and the school showed little interest in the club at the time, but when a rival community received the silver loving cup donated by a Carrollton bank for the best girls' club work the women of the community became interested.

When, at the county fair, the girls' club had an exhibit but was scored low, the women organized, meeting in the kitchens of members, and this women's club was at least partially responsible for the building of a new schoolhouse and the renovating of the church. The next year the Beulah girls' club received the county-fair prize, the silver loving cup. The women also had an exhibit at this fair and won the second prize of $75. The community had become throughly awakened.

The success of the club work, even with no regular and convenient places for the two clubs to carry on their activities, aroused a demand for a club building. The women called a meeting at the home of a member, and six men were among those who attended. At a public meeting a week later one of these men explained the importance of club work and the need of a building, offering to give logs from his farm toward its construction. Other men made similar offers. A community log-cutting day was set. The pastor of the local church added his influence.

On log-cutting day the trees were cut and the logs hauled. The next week there was a community log raising, the women furnishing dinner, as usual, in the schoolhouse. Boards were hauled to town to be dressed for flooring, and in a series of community meetings the building was erected. (Fig. 8.)

In May, 1925, the building was dedicated at a great community rally, with addresses by the judge of the State superior court, a Congressman, and a State senator. The women prepared a free barbecue for 200 people. Club girls in uniform served the dinner on tables built in the grove.

The building is located on the corner of the school grounds 150 feet from the school and 10 feet from the woods, on land cleared for the purpose. The floor is of pine boards, the ceiling of undressed birch covered with boards made locally and local "writhing board" shingles cover the roof. The doors were made locally, but the windows are of ground glass left over from a reconstructed church building. Rag rugs made by club girls are to be replaced by hooked rugs made by the girls. Seats for 40 people are of puncheon logs or smooth-faced slabs, with wooden legs. These are augmented by six purchased chairs. Homemade straw brooms are used to keep the floor clean. Furnishings consist of a kitchen cabinet, dishes, oil stove, sewing machine, and homemade tables.

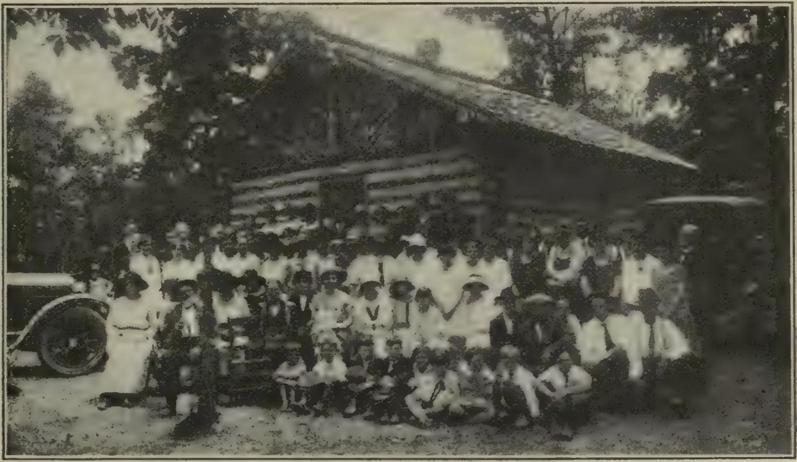


FIGURE 8.—Home demonstration log club house, Beulah, Carroll County, Ga., with a community group in front

The actual cash outlay for the original building was $28 spent for nails, locks, hinges, and the dressing of floor boards. Original and added equipment and furniture cost $75. Everything is paid for, the money coming from receipts from "showers" given in the building. Ownership is vested in the home-demonstration clubs of 30 women and 18 girls, although the building was erected to serve club work and community purposes.

Each club uses the building bimonthly for its regular club meetings and at other times for special work. Girls' club work consists of projects in poultry raising, gardening, cooking, sewing, health, and home beautification. The women's projects are much the same but include child training, school lunches, and the sponsoring of such community activities as school and church improvement and butter-making contests.

Farmers use the building for meetings for the cooperative buying of fertilizer and seed. The purchased material is distributed from the building. Products for display at county and other fairs are assembled here. Specialists from the college of agriculture give stereopticon lectures on various farm and home practices. Social uses include the local meetings in a series of county community meetings, quilting parties, young people's parties four times a year, and community rallies with dinners served under the trees.

This club and community building in an isolated farming locality has had a regenerating effect on the community. Erecting the building has taught the farmers and their families, who are naturally independent and conservative, what can be done by cooperative effort toward the betterment of rural economic and social conditions in a community of little wealth. It has succeeded in bringing together diversified elements in the community. Farming people here have learned that it is not necessary to depend on the town for social diversion.

COUNTY WOMEN'S REST BUILDING

Rest rooms for country women to be used when in town on business are now rather common. Facilities for rest, refreshment, and for the care of children are often provided. A matron is usually in charge of the room. If the room is furnished by a bank or store, the country women are likely to feel that they must deal with the firm if they use the room. Again, it may be provided by a town commercial organization with the inducement to trade in the town as a motive.

More often such buildings are established by women's organizations really interested in the welfare of country women. Money received from public contributions or receipts from entertainments are often used in financing and maintaining the rooms that are not provided by business houses.

In recent years towns themselves have established such rooms, financing and maintaining them with public money. The motives here are mixed. The inducement to trade in the town is prominent. Another motive is the growing tendency toward town and country cooperation. This includes the idea of extending courtesy to guests, together with a gradually dawning realization on the part of town governments of their obligations to those from without the gates upon whom the business of towns depends.

Country women generally appreciate the facilities thus provided and make use of them, but they are sometimes deterred by a feeling that they are using them by favor rather than by right. County governments are now meeting this feeling by providing rest rooms in most of the new county courthouses, but this is not entirely satisfactory, for women are not naturally attracted to a courthouse with its prison, its public trials, and the class of people who sometimes gather there. In most rest rooms, no matter where located, only the most common comforts are provided, and little attempt is made to make the place homelike.

Marshall County, Tenn., has gone a long way toward overcoming the limitations of the usual rest room. Through county taxation alone it has provided a complete new building.

Marshall County has a population of 17,375 people, mostly rural. Lewisburg, the county seat, has 2,711 people and is near the center of the county. The town is largely dependent upon agriculture for its existence. There are the usual number of small villages in the county, the largest of which has only a few hundred inhabitants. The remainder of the county population are farm people. Lewisburg is the natural trading, political, and judicial center of the county.

There was the usual need for a rest room for country women in Lewisburg. When in town for trade or social purposes there was no place for the women to go between business errands or while waiting for others. Mothers carrying children and purchases in arms and leading other children by hand walked the streets or waited on corners. Country women were accustomed to such conditions and accepted them, but the town women planned a remedy.

A county rest room was proposed by the town women. The country women were interested in the proposal, but were not very hopeful. The more the idea of county action was considered the more it seemed that country women were entitled not only to a rest room but to a rest building in order that proper facilities and care should obtain.

The proposition was voted down three times by the county authorities. Country women, long inarticulate in such matters, did not know how to use their influence, but gradually they became united, forceful, and explicit in their demands and the 3-year campaign succeeded.

Now, on the main street, in the heart of the business section of the town, is found the county women's rest building, neat, attractive, well furnished, and well cared for.

The building is a 1-story brick structure with a rear basement. A deep porch with a stone floor, included under the main roof, extends across the front and part of one side of the building. (Fig. 9.)

At the front is the reception room, 22 feet square, which has a fireplace and is furnished with easy chairs and tables. Three rear doors lead into a toilet, a closet, and a hall extending to the side entrance of the building. Back of this room is another room, 20 by 20 feet, arranged as a nursery. It is furnished with two beds, a crib, chairs, tables, and a heater.

In the basement is a room in which simple lunches may be prepared and eaten. A well-furnished room 20 by 22 feet, in the basement, is used as a library. This is called the Marshall County library, but it is really a membership library, with a borrowing privilege at 50 cents a year per member. Three hundred books, together with magazines and reference material, can be loaned or consulted by those using the building. There is also a changeable-deposit collection of books from the State library. This local library loaned 500 books in 1928.

The building is under the control of the officials of the county court and is managed through a matron appointed by the court. It was financed by a county appropriation of $5,000, supplemented by $250 for equipment, and was built on a lot owned by the county. The matron receives $25 per month. Other expenses of operation average $10 per month.

Although this building is primarily for country women, business women of the town often use it, especially in the evening, and the library has a widespread use. The county home demonstration agent uses the building for meetings of her sewing and millinery classes near Lewisburg, for work in connection with the State vocational-education projects, and for food demonstrations for country women.

This innovation of using county funds to erect a rest building for the use of country women while in town on business appears to be a success and to meet with general approval. It seems to solve a recognized economic and social problem, other solutions for which have had their distinct limitations.

It has gone a long way toward making country women feel at home in the town, and they consider it their established bond with town people and town business and social interests. It has also demonstrated that the country women are a power to be reckoned with if they have a just cause and insist upon what they believe is due them.

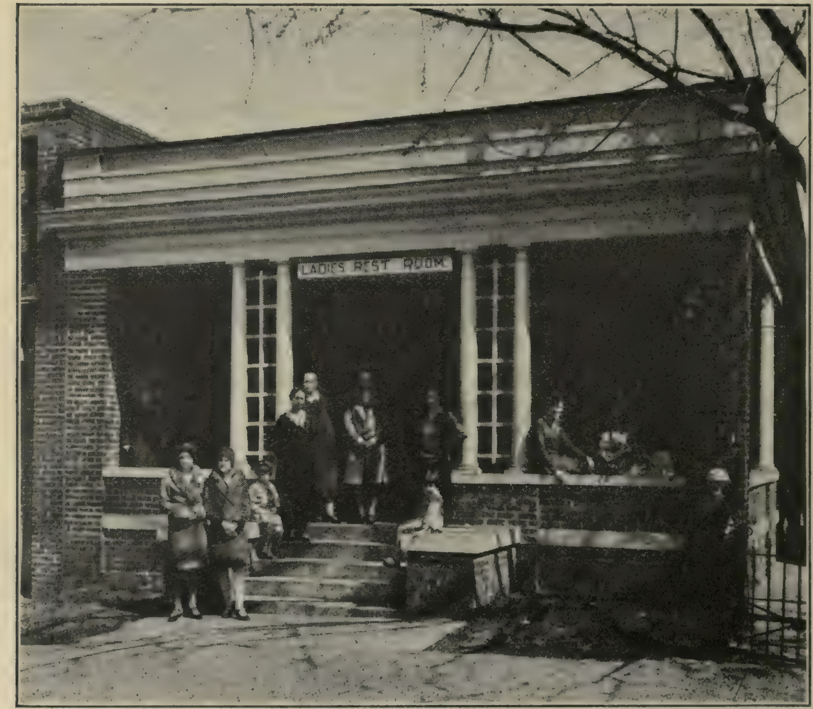


FIGURE 9.—Marshall County Women's Rest Building, Lewisburg, Tenn.

RURAL COOPERATIVE LAUNDRY

The farmers' laundry at River Falls, Wis., was first suggested by the Home Culture Club, composed of 30 farm women whose president had attended a State meeting of the Wisconsin Country Life Club at which the general subject was discussed.

Believing that great economic and social advantages would accrue to rural people through its establishment, the farm women interested the town women, and a canvass was made of the countryside for initial funds through stock subscriptions, although service rather than financial gain was the object. Meanwhile the dean of the State

College of Agriculture had offered a $300 prize for the first successful cooperative laundry in Wisconsin to be established, patronized, and operated for three years by farm people.

A company was formed and incorporated with capital stock of $10,000, each share valued at $10, and each stockholder limited to one vote. A sale of 854 shares resulted, about equally divided between town and country, the majority of stockholders being farmers. A farmers' cooperative creamery building, abandoned when a new structure was erected, was purchased for $1,000, and arrangements were made for the use of power and water from the creamery. Later a boiler was installed in the building, which then became independent of the creamery building.

The laundry opened in 1914 with a working force of 4 members and equipment, valued at $3,500, sufficient for the family wash for the people of the local community. Later the force was increased to 20 members; a rough-dry system, and cleaning, pleating, and rug-cleaning departments were installed, three additions were made to the building and $5,806 worth of equipment was added, all financed through new stock sales and earnings. (Figs. 10 and 11.)

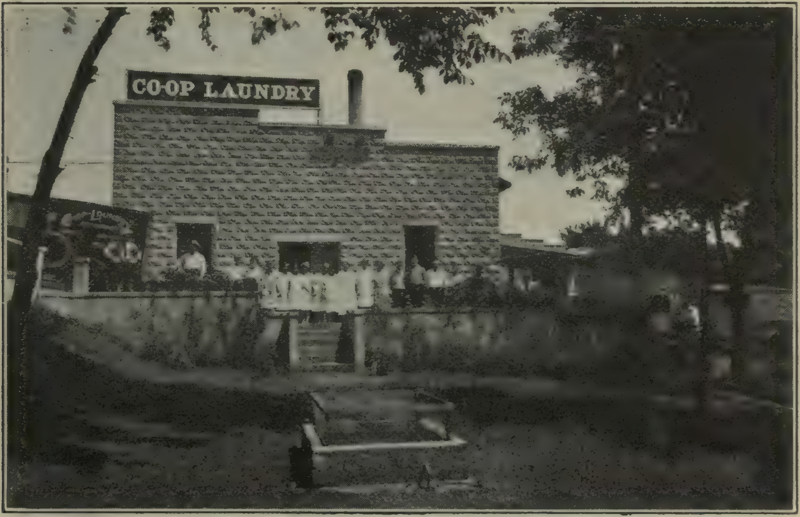


FIGURE 10.—The Farmers' Cooperative Laundry at River Falls, Wis., and the employees

This expansion was needed to meet the demands of an increasing clientele, some of whom lived 30 miles from the laundry. The clothes were brought to the laundry by three trucks, or sent by mail. A new building is now being planned.

On January 1, 1929, the building was valued at $5,547.31. Total assets were $19,138.04, with a total outstanding debt of $2,843.48, accounted for chiefly by new machinery and building operations. There were over 1,200 patrons. The value of the business done in 1915 was $6,857.27; of that done in 1928, $27,798.58. Annual profits have been over $1,000, 6 per cent being regularly paid. The laundry handles 4,500 pounds of washing per week on a 4½-day weekly pay roll of $317.59. The general rate for dry laundry and flat work is 8½ cents a pound. One or more shares of stock, $20 each, are held by 240 persons. Farmers comprise one-third of the patrons. The board of five directors, elected by the stockholders, consists of country and town people, country interests predominating. The present secretary-treasurer helped to promote the company, and the present manager began as a delivery man.

FARM AND HOME ECONOMICS BUILDINGS

Buildings housing farm and home economic and social enterprises are more numerous than those of any other type. The grange, the Farmers' Union, and the equity societies in their local organizations have used this housing plan in a moderate way, believing that social influences are often an aid to farm business, and that the two should not develop separately.

Farm bureaus, more recently in operation, are stressing the value of the idea in their organizations, especially in their women's auxiliaries. In their building movement they give concrete evidence of it, beginning with their locals. In local country communities they are erecting new buildings, or taking over abandoned churches and schools, or renting quarters in which their economic and social interests may be promoted cooperatively. In some places such local government units as the townships or school districts tax themselves, by popular vote, to assist in erecting such buildings. This movement is probably most active in the States of Iowa and California. Valuable county farm bureau buildings are also being erected or acquired.

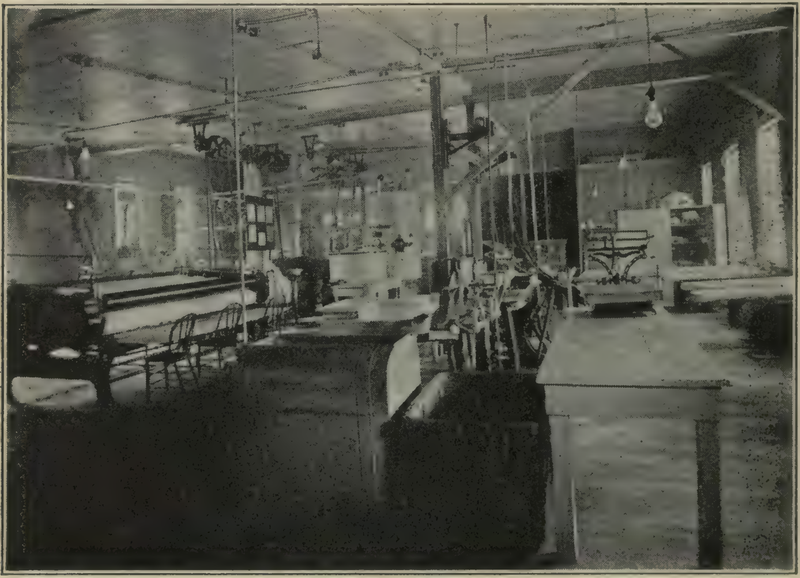


FIGURE 11.—The interior of the finishing department of the Farmers' Cooperative Laundry, River Falls, Wis.

The extension movement has resulted in the erection or acquisition of buildings promoted by the community as the headquarters for boys' and girls' club work. This tendency is rapidly growing. Related to these buildings are the fairgrounds buildings for the exhibition of club work, promoted by the community or the fair association. Another relation is found in the boys', girls', and women's club camps, often with valuable buildings, that are being promoted by districts, States, and areas.

A notable tendency is for rural community buildings, largely social in their purpose in the past, to be erected to include farm economic activities. Thus they tend to become actual community buildings representing and uniting local economic and social interests. The McKinley Farmers' Club, in erecting their building at Kensal, N. Dak., gave as their aim, "To buy supplies in carload lots and save the middlemen's profits." The Orchard Homes Country Club, which has a building near Missoula, Mont., is given credit for the establishment of county extension work. The county agent of Logan County, Ill., gave the Emden community building a large share of the credit for the success of his work in that part of the county. The building at Stewardstown, W. Va., was a local extension project. Another example of the combination of economic and social activities is the extensive office building with recreational facilities for employees, which members may use, erected in 1928 by the Mutual Orange Distributors, a large cooperative at Redlands, Calif. The Fruit Growers Supply Co., a subsidiary of the California Fruit Growers Exchange, has erected a community building at Susanville for employees at a cost of $45,000.

Many counties are erecting or securing buildings to house agricultural officials and economic and social interests. Augusta County, Va., has erected a $100,000 building with a large auditorium, near the county courthouse at Staunton, largely for this purpose. Another variation is the stock sales or show community buildings. Examples are found at Argonia, Kans., Logan, Iowa, and Clinton, Okla.

COUNTY FARM BUREAU BUILDING

The county farm bureau of Macon County, Ill., was organized in 1918 with 300 members. The first headquarters were in a room 6 by 18 feet, in the courthouse.

In 1920, by a practically unanimous vote of the 800 paid-up members, they bought a recently constructed sales building and garage at a total cost of $28,000. The terms were $8,000 down, and a mortgage on the building for $20,000, with $1,000 due annually for 10 years, when the final $10,000 payment was to become due. New furnishings came to $1,000, and the erection of partitions to $250. The $8,000 paid down came entirely from membership fees.

In 1923 the producers' market was organized and in 1927 the Macon County Supply Co. The latter is a cooperative, nonprofit farmers' organization having for its purpose the giving of business service to bureau members by buying and selling materials for farmers. Total sales for the first year were $84,830, with a net profit of $6,417.

By 1928 this building became unsatisfactory as an investment, since its space could not be effectively used for the purposes intended. Near-by parking space for farmers was not available. It was decided to sell the building, a valuable one for its original purpose, and use the money to construct a new building, especially planned for the various growing activities of the bureau.

A building was needed so arranged that complete farm bureau service could be given effectively. This would include office space for the extension service and other organizations working with the farm bureau, a well-designed place for group meetings relating to the farm bureau, to adult and junior projects, and to other activities, and a place for farm-product displays. A location convenient to the business section, with abundant parking space, was needed because of the increasing business of the market and the supply company.

The cost of the new plant is itemized as: Grounds, $6,000; leveling of grounds, $722; alley, parking space, and sidewalk paving and retaining wall, $500; and the building, $12,000; total, $19,222. Old equipment was used and some added; with the $2,022 reserve for depreciation this is valued at $1,246, making the January 1, 1929, value of the plant, $20,468.

The farm bureau sold its interest in the old building for cash. It received enough to pay off the old indebtedness and had a balance of about $10,000. This was applied largely to the purchase of a lot for the new building, with the result that there is a mortgage on the new building of $10,000.

The old building was occupied about a week less than six months during the year 1928. There was an interval of occupancy of rented quarters until the new building was occupied, about November 1, 1928. Maintenance expenses in the new building were about the same as in the old. For the year 1928, maintenance expenses for the old building were: Heat, light, and water, $340.94; interest, $715; insurance, $43.50; furniture, $300; total, $1,399.44. Membership fees constitute the largest source of maintenance funds.

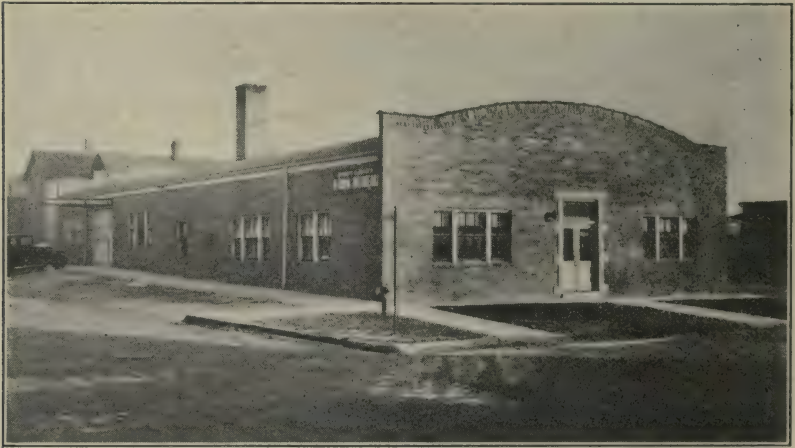


FIGURE 12.—Macon County Farm Bureau Building, Decatur, Ill., showing producers' market outside entrance at rear

The building (fig. 12), a 1-story brick structure, 50 by 100 feet, is located two blocks from the business district on a lot that is 98 by 110 feet. The ground around the building was leveled and paved for automobile parking. To the right, as one enters the building, is the lobby, 30 by 18 feet. Beyond the lobby is a hallway, 10 feet wide at its entrance, leading to the combined market-assembly room in the rear. The right of the lobby is equipped with bookcases and tables. Back of the lobby, and separated by folding doors, is the director's and conference room, 19 by 22 feet. Back of this are the women's rest room and the men's rest room, each about 6 by 19 feet, and arranged with lavatory, toilets, and alcoves for clothing. These have hall entrances. At the left of the lobby and separated from it by a counter is the general office, with desks for the county agent, the office secretary, the secretary of the county fair association, the county tuberculosis inspector, and the secretary of the supply company. Beyond the office are a stock room, 8 by 16 feet, the furnace, and the boiler room.

The rear is devoted to the produce market assembly room, 50 by 50 feet, with a second entrance from the side street. (Fig. 13.) With the movable market equipment taken away, this room seats 225 people as an assembly room. Gas is piped into the building, and electricity is available so that an arrangement for cooking may be made. The heating system is steam with a motor pump supplementing the return system. The lighting system is one of electric conduits with conveniently placed lights. City water supplies the building.

The producers' market originated with member farmers and their wives who wanted to sell produce direct. A bureau committee was appointed to study the matter, and the market was adopted by the bureau as a service project, with a committee in charge, which appointed a manager, a farmer, who receives about $275 yearly for his services. Market day is regularly Saturday, additional days being used near holidays. Twenty or more booths are occupied each market day and a gross yearly business of $30,000 is carried on, all net profits going to members. Among the products sold are baked goods, fresh pork and beef, butter, eggs, dressed chickens, cabbage, cheese, baked beans, whipping cream, and miscellaneous seasonal farm products. The market is popular with the town people and it is planned to extend the number of booths.

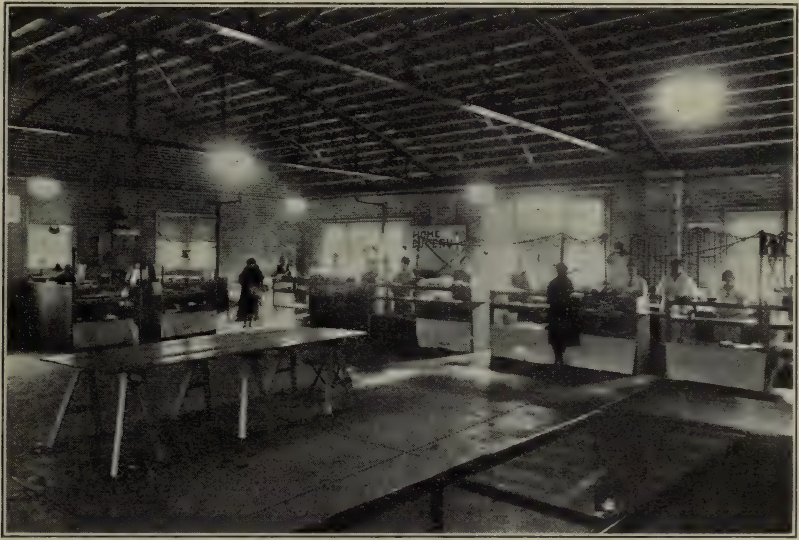


FIGURE 13.—The south and east sides of the market-assembly room of the Macon County Farm Bureau Building, Decatur, Ill.

It was not contemplated that this building would become a social center, as the different farm communities usually formed their own social centers, but as the county agent expressed it:

> We like to stress the farm-bureau building as a place where farmers may meet neighbors from the other parts of the county, and too, we feel that it is their city home, and a sort of clubroom where they can feel at home.

During December, 1928, over 600 people came to the building in addition to those who attended meetings. Folding doors between lobby and conference rooms make it possible to combine these rooms for small meetings to accommodate as many as 100 person. Thus, two meetings can be held in this building at the same time. During November and December, 1928, meetings in the building were held by the supply company; by schools for dairy feeding, farm management, and farm-accounting classes; by the fair association; by the poultry leaders; by the livestock-marketing leaders; by the home bureau, the farm bureau, the directors of the farmer's institute; and by the antihorse-thief association. The county 4-H club community show was also held here during that period.

The market room has been used for the program meetings for the opening days of the building, with 200 to 250 in attendance at each meeting; the annual meetings of the bureau, of the supply company, and of the fairground trust, and for rehearsals of the home bureau play. The old building was used also for the farmers' institute 3-day meeting and for their annual community shows; for dinners by the local churches; meetings of organizations of the local schools; by the boys' club and the 4-H club; by women's clubs; by 15 to 20 project meetings annually; for large group meetings held by the home demonstration agent and for joint boys' and girls' club meetings.

Because of this ownership of building by the county farm bureau all agricultural activities of the county have a convenient center, and time and money are saved for agricultural people and interests. The county agent said:

> We are exceedingly well satisfied with our building, and the few people who were not much in favor of selling the old building and relocating are very much pleased with the new management and new location.

FARM CENTER BUILDING

Knightsen, a village of 116 people, is in a fruit-growing section of central California in Contra Costa County. The nearest town (population, 1,936) is about 15 miles distant. The two villages of 320 and 216 population are a few miles away.

The farm center, or farm bureau, had no convenient place to carry on its activities, as there was no hall in Knightsen or the vicinity. The organization had been using the 2-room schoolhouse, but this was inconvenient, for desks were too small and were fastened down. The farm center wanted a place for dances and moving pictures and for farm and home demonstration work.

It formed the Knightsen clubhouse corporation, adopted by-laws, and began to gather subscriptions. To every person who subscribed $10 a certificate was given providing for life membership in the corporation. This certificate entitled the holder to vote at elections and meetings, even though not a member of the farm center. Voting privileges to farm-center members came automatically with the payment of the regular annual dues of $10.

The building was dedicated February 1, 1921. It is a 1-story wooden structure consisting of two main parts. At the left is the main hall, 60 by 40 feet, with a stage 24 by 14 feet and dressing rooms. On the right side the structure is 40 by 40 feet and includes the dining hall and club room, kitchen, lobby, and toilets. There is a covered porch in front which includes a ticket booth. (Fig. 14.)

The equipment consists of many folding card tables, dining tables that will accommodate 100 people, folding chairs, benches, a piano, two heating stoves, and kitchen equipment which includes an oil stove and dishes to serve 200 people. The kitchen is provided with a sink, cupboards, and running water. Electricity provides light for the building. A moving-picture booth was first included in the main hall, but this was later removed, and the windows were wired when basket ball was included as an activity and moving-picture houses were established in near-by villages.

As often happens when men undertake the major responsibility in planning a building, mistakes were made in kitchen arrangements. The women soon rectified them, however. Narrow, high cupboards were replaced with wide, lower ones, more conveniently placed. Drawers for silverware, formerly under the sink, were placed under the new cupboards. A serving shelf $3\frac{1}{2}$ feet wide was installed on one side. A kitchen table was made that fits under the serving shelf and that can be pulled out so that all four sides of it can be used. Having demonstrated what they can do, the women are planning the installation of an electric stove and a drinking fountain.

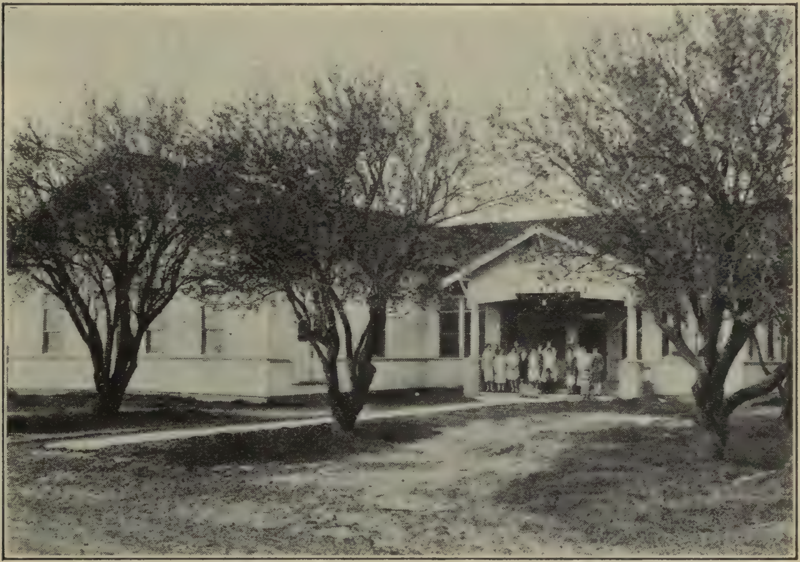


FIGURE 14.—Knightsen Farm Center Building, Knightsen, Calif.

The first cost of the building and equipment was $6,500. The two lots were a donation. Equipment expenses included the piano, $650; tables, $150; heater and ventilator for the hall, $200; and chairs, $150. A chimney cost $75. Benches were made and donated. The cost of rearranging the kitchen, exclusive of voluntary labor, was $85, the net receipts from two events. Dishes and an oil stove costing $67.25 were already in the possession of the farm center.

When the building was completed there was a $3,000 debt on it. Of this amount, $2,000 was due to a bank and $1,000 to three people who had advanced the money. Since then the $2,000 debt has been reduced to $1,500 and the $1,000 debt has been paid, largely from receipts from entertainments given in the building.

Annual maintenance expenses involve, chiefly, electric lights, $40; water, $12; and insurance, $20.

This building is in use practically every day. The local farm center uses it for its monthly business meetings, at which one of the county agents often gives a demonstration. Carload-lot purchases of chicken feed and other farm supplies are arranged for at these times. Fairs and product displays are held, as are frequent joint meetings with two neighboring farm centers. The farm center also uses it for theatricals, card parties, dances, banquets, and other forms of entertainment.

The building is used for monthly and special meetings by the county home demonstration agent, at which time demonstrations are given on nutrition, cooking, canning, home decoration, sewing, and kindred subjects. Once a month the 4-H clubs meet here and conduct demonstration work. There are occasional meetings of the Eastern Contra Costa County Chamber of Commerce. Schools have their graduating exercises here, and churches and Sunday schools use it. The local and federated parent-teachers associations meet here. Precinct primaries and elections are held in the building, as are meetings of political organizations. The officials said:

> We could not have a live center without this building in which we are enabled to combine our economic and social activities, each reacting favorably upon the other. We are justly proud of our clubhouse and all it means to our community as an economic and social benefit.

TEMPLE OF AGRICULTURE

The Temple of Agriculture is owned by the Elephant Butte irrigation district, a farmers' organization of over 2,000 water users around Las Cruces, N. Mex., a town of 3,969 people. In addition to being the official and community home of the water users, the building is the headquarters of the county farm bureau, the local farm loan association, the United States Reclamation Service, and other organizations that serve farmers, and is the meeting place of a variety of farm organizations.

The farm bureau has 280 members. It organized the Southwest Irrigated Growers Association, a cooperative organization. Business men organized the Mesillo Valley Cotton Growers Association, not a cooperative.

Previous to 1921 the offices of the Elephant Butte irrigation district were in rented quarters. In that year it bought a building in a good location near the center of town and remodeled and equipped it. Other organizations relating to farming were assembled in the building. An assembly hall, rest room, and kitchen were provided, and the building became a business and social center. (Fig. 15.)

The building is a 2-story brick structure 71 by 33 feet. A hall runs through the first floor to a shed annex in the rear. On the left are the general office of the Reclamation Service, followed by the project engineer's office, the office of the manager of the Elephant Butte irrigation district, a women's rest room, and two toilets. On the right is the general office of the Elephant Butte irrigation district, its cashier's office, and a large room containing offices of the county farm bureau, the farm and home extension agents, and the Messillo Valley Farm Loan Association. On the second floor, across the front, is a small assembly room in which the hydrographer of the Reclamation Service has an office. In the center is a combined assembly hall and rest room, 48 by 31 feet, at the rear of which are a kitchen 9 by 19 feet, a pantry, and a toilet.

The assembly room is furnished with dining tables and chairs to serve 100 people, armchairs, couches, rocking-chairs, a desk, and a piano owned by the farm bureau. In the kitchen are a sink, two oil stoves, several tables, cupboards, and adequate dishes. Electric lights, steam heat, and running water are available.

The building was bought for $6,000, with annual payments that would about equal the former rentals, and is now paid for. It was remodeled, a heating plant was established, and furniture was installed, making the present valuation of the plant $14,058. The irrigation-district furniture is valued at $3,000. The furniture and fixtures of the other services using the building are valued at $2,000.

Total annual building maintenance expenditures for 1926 were $1,501.16. Primary expenditures are: Janitor, $600; fuel, $160; and light, $300. Water, if paid for, would be $30. The Reclamation Service pays $60 a month rental and takes care of the building and its maintenance. This is not the main office, as that is located in another building. The farm bureau pays no rent.

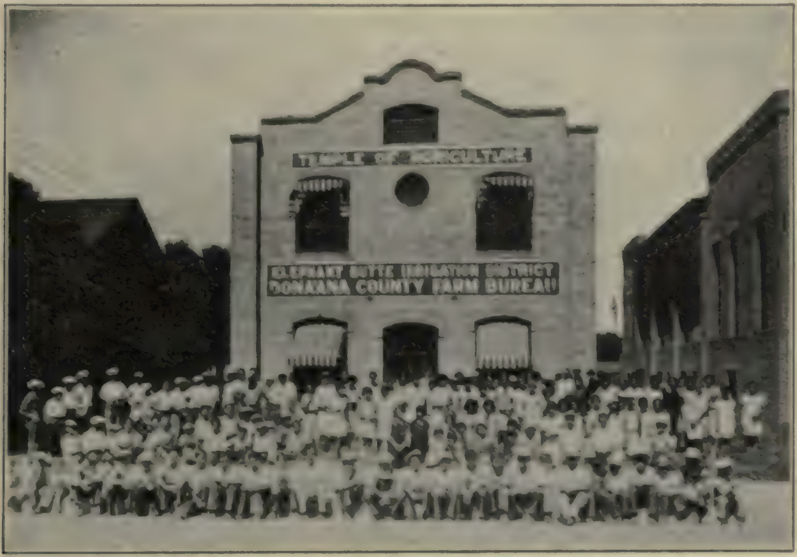

TEMPLE OF AGRICULTURE
ELEPHANT BUTTE IRRIGATION DISTRICT
DONA ANA COUNTY FARM BUREAU

FIGURE 15.—Temple of Agriculture, Las Cruces, N. Mex., with 4–H club members

The water users elect a board of directors of nine members, who in turn elect their own officials. The directors have charge of the building. The assembly hall is in direct charge of a committee of women who are heads of local farm bureaus appointed by the directors of the farm bureau.

Except for the assembly hall, rest room, and kitchen, the building is used entirely for farm and home economic purposes involving a number of organizations and individual farmers.

The building is used for a variety of meetings that are economic in character. They include those of the directors of the irrigation district; of farmers considering irrigation policies, marketing, etc.; of the county farm bureau; of local farm bureaus; of the west regional conference of American Farm Bureau Federation; of the Mesillo Valley Cotton Growers Association; of the Southwest Irrigated Cotton Growers Association; of the Rio Grande Valley Dairying Association; of local dairy interests; of the directors of farm loan association; of the poultry association; of the budget committee of county schools; of the ditch riders' organization; of directors of farm bureau men and women; of 4–H club leaders; of those coming to see farm and home demonstrations by the county agent and home demonstrator; of the county agent; of group leaders of the 31 locals; of those attending demonstrations by the State team of demonstrators (one of the locals); of the farm women's council; of the junior-encampment committee; and of members of the handicraft schools. There are about 800 farm bureau and boy and girl club members.

Social uses include all the usual diversions. Farm and home demonstrations are usually followed by social features. The hall is rent free, but town organizations are not encouraged to use it, as it is considered largely a community center for farm families.

It was the common local opinion that many advantages accrue, both to town and country people, in having the economic and social interests of the farm men and women and their organizations center in this one building. The major economic interests of the farm people relate to reclamation, irrigation, financial loans, farm and home demonstration work, boys' and girls' club work, and the marketing work of the various organizations to which they are attached. With the various related economic services centered in this one building, all moving toward a common end, the officials and employees not only accomplish their own work more efficiently but also more effectively serve the farmers. By having their social and economic interests grouped in the one building, farm people come to know their officials better and have greater understanding of the work they are trying to accomplish, and thus more readily lend their confidence. Officials have an opportunity to develop a greater insight regarding not only the farmers' problems but their points of view and habits of thought.

BOYS' AND GIRLS' COUNTY CLUB BUILDING

Boys' and girls' club work may be seen in fine fruition in Hillsdale County, Mich. In the spring of 1928 there were 505 boys and 360 girls carrying on planned and directed club projects. Projects were completed by 91 per cent of them.

The success of the work may be gaged by the county club work financial statement for 1927.

TABLE 1.—*Financial statement of the boys' and girls' club work in Hillsdale County, Mich., 1927*

Project	Value	Cost	Profit	Project	Value	Cost	Profit
Corn	$1, 560. 00	$624. 00	$936. 00	Calves	$54, 600. 00	$38, 220. 00	$16, 380. 00
Potatoes	3, 155. 22	913. 20	2, 242. 02	Sheep	14, 010. 00	10, 274. 00	3, 736. 00
Handicraft	410. 75	217. 60	193. 15	Poultry	3, 650. 00	1, 679. 00	1, 971. 00
Sewing	588. 00	310. 00	278. 00				
Canning	3, 282. 60	1, 641. 30	1, 641. 30	Total	89, 776. 57	59, 339. 10	30, 437. 47
Pigs	8, 520. 00	5, 460. 00	3, 060. 00				

Through all the economic and social work there was yet something lacking—something which would serve to link together all their activities; that would help to give the collective force to their individual endeavors; that would contribute to the permanence of their work; that would typify "each for all and all for each." They had long recognized the need for a county building, primarily as a center for their own economic and social activities, but also for the use of country and town people and organizations.

For instance, club members had been coming in at fair time several hundred strong, with their exhibits, and camping in tents on the grounds. The days of the county fair were the big days when the results of their efforts through the year were analyzed, judged, and, perhaps, rewarded. But tenting was unsatisfactory, especially in stormy weather.

In the early part of 1926 a county road commissioners' building was advertised for sale. The commissioners were asked to transfer it for use as a club center, and it was planned to move it to the fairgrounds and rebuild it. The commissioners agreed to sell it on the payment of $1 and on the condition that club members would tear it down without cost to the county. A county club meeting was called, which included parents and members of other interested organizations. The result was that the building was torn down by the boys, removed to the fairgrounds on the edge of town, and the lumber used as a nucleus for constructing a new building (fig. 16) in time for the opening of the county fair in September, 1926.

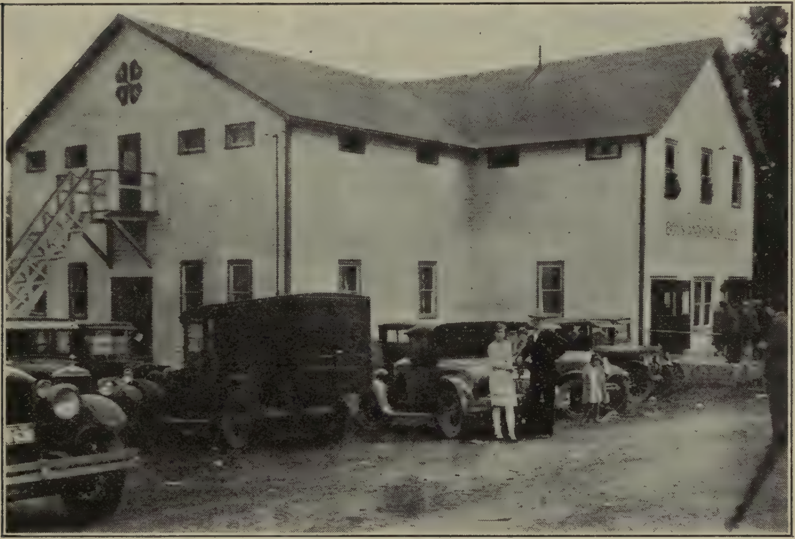


FIGURE 16.—Boys' and Girls' 4-H Club Building, Hillsdale, Mich.

The actual amount of money spent on the original enterprise was $6,350. The old lumber was valued at $2,000. The building and equipment are now insured for $12,000. Of the amount actually expended, $3,000 was raised by country people, $1,150 was donated by the fair association, and $2,200 was borrowed.

Raising the money was a popular county enterprise. At the first meeting called for the purpose a general committee was formed consisting of three members from the board of commissioners and two members at large. Each of the 18 townships and the 4 town wards was allotted a certain quota of money to raise by subscription or other means. In some cases two or three citizens of each township furnished the township quota at once and gave the club boys and girls a chance to earn and repay it. In some townships every home was canvassed for subscriptions by club members. There were from 30 to 100 subscriptions in many townships. Other townships raised their quotas by entertainments. All except $1,000 of the money borrowed has been repaid through entertainments given by the club members in the building.

The building is a 2-story-and-basement pine structure, the main part 80 by 40 feet, with a 28 by 18 foot addition. The basement is 7 feet high, with a concrete floor. In addition to the main room it has a kitchen and a girls' retiring room. The main room is equipped with tables and benches to seat 500 people and has a "parlor furnace." The kitchen has a gas range, three oil stoves, two sinks, cupboards, and an ice box. There are dishes for 100 people.

The first floor is the exhibit room, used also as a meeting place and a club demonstration room. At either side of the entrance is a room where refreshments are sold at fair times. In the exhibit room are 10 decorated display booths, each 4 by 12 feet, furnished with benches. A base-burner heats the room.

On the second floor are two dormitory rooms, each 40 by 40 feet, furnished with 100 sleeping cots for the club members who attend the fairs. There is a toilet and a fire escape in connection with each room. The roof of the building is of asphalt. The building is lighted by electricity and has water and sewer connections. The interior still has the rough finish, but future plans call for a ceiling and a large heating furnace. The floor plans were prepared by the county club leader and approved by the State safety department.

For purposes of permanency the ownership of the building was vested in the county fair association with an understanding in the contract that the club members should have a life lease on it for club purposes.

County club work is organized on the township-unit plan, each unit having its own elected officers and a man and a woman supervising the work without charge. The county organization is made up of the regular township officers and a reporter from each township. Annual elections are held at the time of the fair. The county organization supervises all county exhibits and meetings. Local exhibits are frequently held. A county boys' and girls' mothers' association has been formed, which looks after the general welfare of the club members at camps, fairs, and meetings. The mothers supervise the culinary department at county-fair time.

The chief reason for the erection of this building was to secure headquarters and a dormitory for club members and a display place for their exhibits during the time of the county fair, and these are its primary uses.

During the rest of the year there is regular county club work twice a month, and county club meetings and township club meetings with attendant social events are held. There are also special entertainments. Plate dinners and banquets are served to the public and various local organizations in order to earn money to repay the loans made for the erection of the building.

Besides the regular club work there are extension meetings led by the county agent, farm bureau meetings and socials, poultry meetings, family reunions, high-school graduation festivities, boy-scout meetings, and games, Sunday-school meetings, county Young

Men's Christian Association conventions, meetings of the grange, church meetings and dinners, and American Legion banquets.

As this building is only a few blocks from the business center of this town which has a population of 5,476, it serves, in addition to club members, all town and country people. It can be used rent free, except when admission is charged. The county fair association keeps the building in repair and attends to maintenance expenses, as it realizes the value of the boys' and girls' club work and their exhibits to a successful county fair of the better kind and to a good type of rural life .

The erection of this building has proved an excellent investment for the country boys and girls, for the agricultural society, and for the people of town and country. It is a permanent and convenient place for fair exhibits and for living quarters for the boys and girls, under proper supervision, during fair times. It has brought the club work adequately before the public, for at each local exhibit club-work material to the value of $75,000 is properly displayed.

The fair itself is a decided educational and social stimulus to the country children and their parents. Club members have free admission to the fair and have many good times. The new building stimulates club work, and club work promotes the success of the fair, which has many features other than club work. Moreover, the building is an asset to the county. Heretofore there was no building in the county where community events could be held without charge or to which there was not attached some other limitation. Rental funds for club meetings have ceased to be a problem.

The erection of the building has promoted town and country cooperation. Business men now pay greater attention to what the farm boys and girls are doing, as they see them working on sound business projects. Previously the club met in town only twice a year, but it now meets twice a month. This brings from 100 to 700 country people to town each time.

COUNTY DEMONSTRATION CLUB HOUSE

Cordial relationships exist between town and country in Ware County, Ga. Commercial interests, organizations, and leading citizens of Waycross, realizing their dependence upon agriculture, give it sympathetic encouragement, and farming people reciprocate this attitude.

Until 1924 the offices of the county demonstration agents were in the second-floor rooms of the chamber of commerce. The county agricultural board, which has 12 town and country members, has 21 prominent town and country committee helpers. There are a number of " buddy clubs " in which town people finance farm boys and girls in the purchase of purebred egg settings, pig litters, etc., their loans being repaid from the increase. A leading woman of the town, a farm owner, centers her outside interests on the human side of agriculture. Business men furnish conveyances to transport boys and girls to the State club camp each year.

As a center for these common social and economic interests a building seemed desirable. The idea was sponsored by the county agents and interested citizens.

The purposes of the new center were well defined when the building was once decided upon. It would put the two county agents' work on the first floor in a county building rather than in the municipal building, which was an advantage, since the county government was much interested in their work. There would be a common town and country center. The agents would have a place of their own for their offices and to carry out their demonstrations. Country people coming to town would have a point of common interest. Town people interested in the development of agriculture, both social and economic, could meet there the leaders of agriculture. The center would provide the boys and girls, and the agricultural club members, both men and women, with county headquarters.

It was natural that the farm-owning town woman should assume the lead in securing the building. The county was in possession of a good vacant building, a former jail, since other provisions had been made for county prisoners. It was a well-built structure of good appearance, located near the center of the town. The county commissioners were persuaded to turn this over for use as a county community clubhouse. Remodeling and furnishing were accomplished through the cooperation of town and country people and governments. The half acre of ground was sown to grass, and flowers and shrubs were planted.

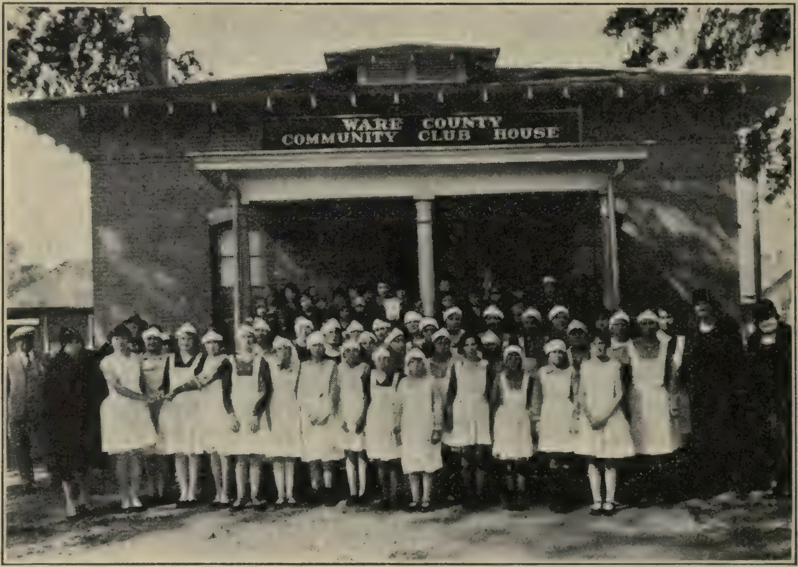


FIGURE 17.—Ware County Community Club House, Waycross, Ga., and 4–H club girls promoted at "achievement day"

In 1924 the building was occupied. It is a 1-story, 4-room building, 40 by 60 feet. There is a carpeted recreation room furnished with settees, tables and chairs. The comfortably furnished clubroom, 40 by 30 feet, has a blackboard, a heater, and an outdoor canner donated by the chamber of commerce. The kitchen has a gas range, sink, water cooler, table, cupboard, and other kitchen equipment. Shelves are filled with jars of fruit. The office, occupied by the county agents, has the usual office equipment. The building is equipped with electric lights, running water, telephones, and toilet. The county furnishes wood and coal for heating purposes. Books from an exchangeable collection sent by the State library commission are in the building for lending.

The building is largely the center of agricultural and home demonstration work. The county agent has 12 boys' clubs with 190 members. In 1927 they won 850 pig club prizes at the State fair. In 1928 efforts were centered on purebred calves. There are teams for demonstrating stock judging and clubs for dairying and for pig, calf, poultry, cotton, potato, corn, and peanut growing. The team leaders meet in the building, take up their projects, discuss their problems, and make their plans.

The home demonstration agent has 210 girls in 12 clubs and 105 women in 5 clubs. The building (fig. 17) is used for canning purposes nearly every day during the season and semiweekly in winter. Sewing and basket-making classes, health lectures, baby contests, and cooking demonstrations are held in the building. Club graduating exercises, special agricultural meetings, community fairs, and meetings of the home demonstration council and the county agricultural board and its 21 committee helpers are held there. The club members hold the usual social events, as do other town and country people. Farm bureau leaders make it their headquarters.

A central building given over to agriculture where town and country relationships center, has the enthusiastic support of the county agents, the county board, and town commercial interests. It is the connecting link for town and country cooperation. It stimulates agricultural cooperative activities. Here country people exchange ideas and experiences. The aims and problems of agriculture are revealed to a sympathetic urban people who become interested promoters of club work. The convenient assembly room and kitchen make possible a leadership in actual demonstration work otherwise unattainable. The economic and social sides of agriculture here become mutually helpful.

COMMUNITY BUILDING

Blue Grass, in Indiana, is near the center of a farming district about 8 miles wide by 15 miles long, consisting of several small communities without a village setting, which are becoming, in effect, one powerful community. There are four open-country churches in the district served by one minister at Blue Grass. Mail service to Blue Grass is from a post office 8 miles distant, and the county agents are at Evansville, 12 miles away. The district is entirely an agricultural one; grain and dairy farming claim the chief interest of the farmers.

From being an ordinary farming district it has, in the last few years, come to be among the best. A member of the boys' 4-H club has for three years won the annual blue-ribbon pig prize for the United States. From a scrub-stock community it is becoming known as the breeder of purebred Jersey cattle. In 1925 the superintendent of the Blue Grass Sunday school was the first to receive a gold medal which had been offered for eight years by the Indiana Dairy Association, for the State of Indiana, for the dairy herd that would meet certain standards. He received the same first prize in 1927 and in 1928. In 1925 the American Jersey Cattle Club selected this herd to be their official exhibit at the National Dairy Exposition held that year at Indianapolis.

The community building (fig 18) grew out of the desire of the minister for a place for the farm youth to play as a counterattraction to the beckoning city lights. From farm baseball teams representing the smaller communities, meeting in a community playground organized in a cow pasture, came the organization of other activities and finally the need for a place to meet. The various churches and the general conference encouraged the movement, and the people themselves carried it out.

Several meetings were held with representatives from the other church communities, the project was discussed, and a campaign for funds was planned. After a 3-month campaign, during which teams from the various communities secured pledges, sufficient funds were in sight, and building plans were secured. The building was erected in 1922.

The building is an attractive 2-story wooden structure with full basement, set among the trees at the junction of main traveled roads some distance from the church. The main or rear part is one high story to facilitate its use for games.

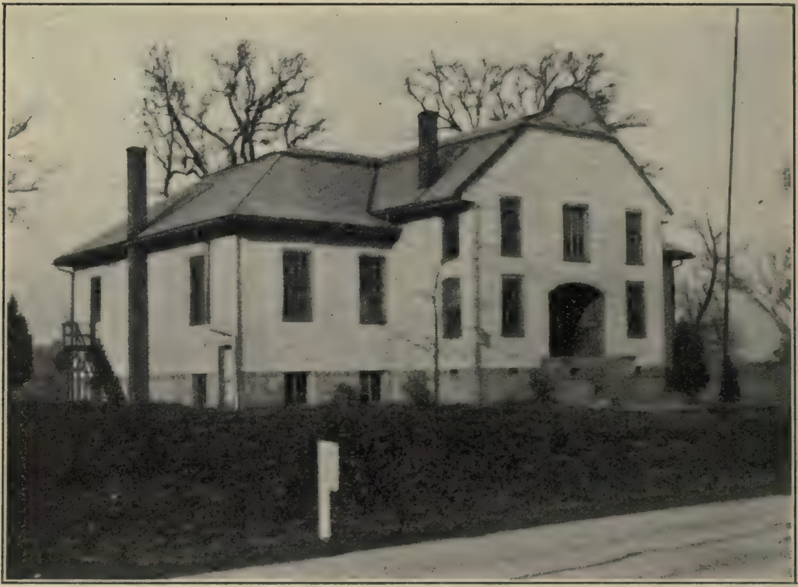


FIGURE 18.—Blue Grass Community House, Vanderburg County, Ind.

The front portion is 30 by 16 feet. In the first-floor center is an entrance hall, approximately 16 by 15 feet. At the right is the office, a toilet, and the stairway to the second floor. At the left is the women's rest room, a toilet room, and the stairway to the basement. The first floor of the main part of the building is 46 by 70 feet and contains the auditorium, together with the stage, settings, and dressing rooms. The auditorium is 55½ feet long by 44½ feet wide. The stage, 3 feet above the floor, is 30 feet wide by 13½ feet deep. The proscenium opening is 9 feet high and 24 feet wide. The auditorium has 200 movable chairs and is also used as a gymnasium and for basket ball.

In the second floor of the front portion is a social room with a fireplace. A branch of the county library is kept here. The fireplace makes it possible to use this room for social and reading purposes and for committee meetings without a fire in the furnace.

In the basement, under the auditorium and of about the same size, is the dining room, where banquets, other assemblies, and community fairs are held. At one end are the kitchen, china closet, furnace room, fuel room, and light plant. Since the building was erected the part under the front portion has been excavated and locker rooms and showers installed. The building has its own lighting plant, but since the community has adopted as its immediate project the building of an 8-mile electric line they expect soon to have the regular electric-lighting system.

The building was carefully planned for its contemplated needs. (Figs. 19 and 20.) Specialists from the State agricultural college were called for a 2-day conference, and the bureau of church architecture in Chicago was consulted. From the United States Department of Agriculture a model community building plan, bulletins on community building plans, and a suggested program of work for the committee were secured, which were studied. Finally an Evansville architect drew up the plans and specifications, which were approved by the bureau of church architecture. The building has proved satisfactory except that the ceiling of the gymnasium is not quite the 18-foot height desired for basket ball.

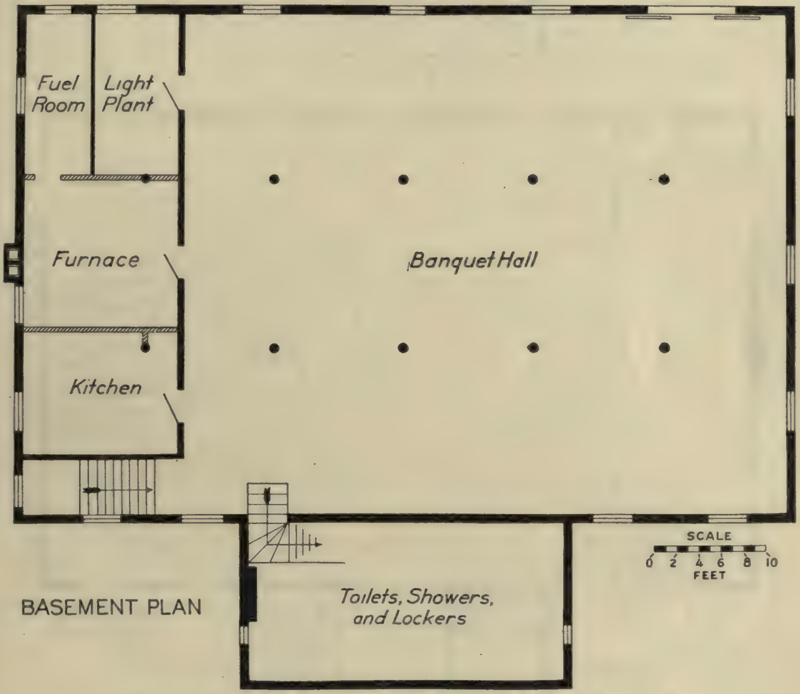


FIGURE 19.—Basement plan of the Blue Grass Building

The total cost of the original building and equipment was $17,293. Aside from the $2,000 given by the church centenary fund, the money was secured by pledges on a 5-year basis from the farm people and organizations of the several communities. An Evansville bank furnished the money, which was repaid as pledges became due. One of the finance leaders says that one of the most important things is for the signer of a pledge to pay his own interest to the treasurer of the building committee, who can then pay the interest at the bank without using the pledge money. This they did not do.

Pledges were signed by over 300 people, in addition to the pledges made by various church organizations. The largest organization pledge was $600. The 300 individual pledges ranged up from $5; many paid their pledges by working on the building.

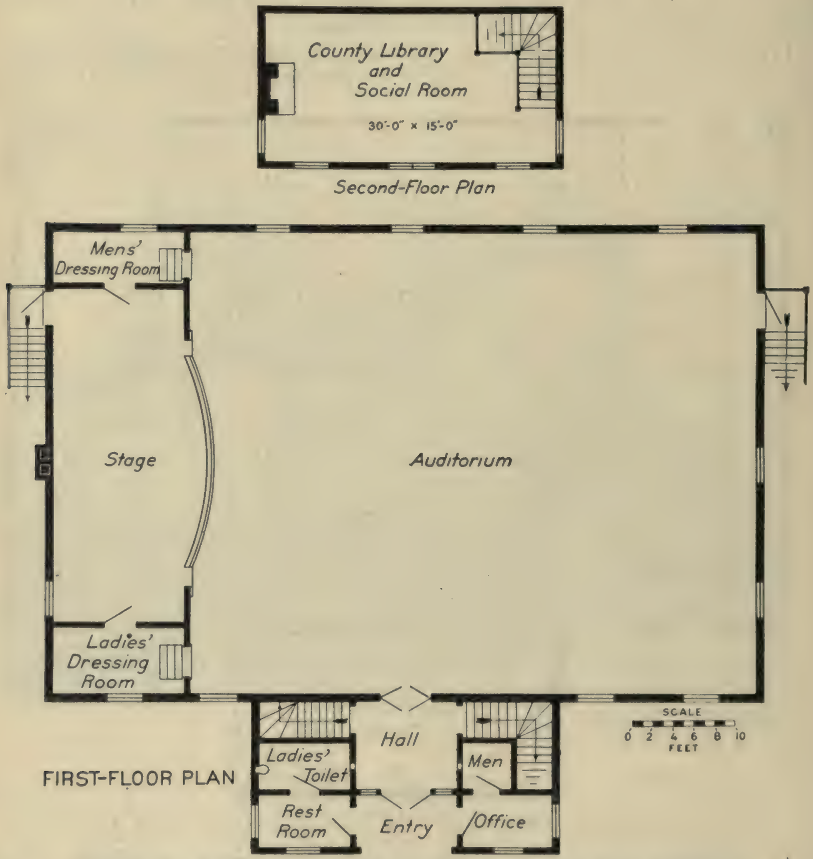


FIGURE 20.—First and second floor plans of the Blue Grass Building

The building and its activities are maintained by a fixed percentage of the receipts from entertainments and games, especially basket ball, given in the building.

The church owns the building and controls it through a board of 5 trustees, 1 elected from each church and 1 at large, elected in the same way that the church trustees are elected.

The uses to which this building has been put are indicative of the significant place which a community building may have in the life of a rural community which organizes itself for advancement along economic and social lines. All boys' and girls' club activities center here, as well as the farm and home demonstration work among the men and women. The social life is greatly stimulated by active interest in such events as athletics, orchestra and band practice, and entertainments, community-fair exhibits, home-talent plays, debates, choral societies, lyceum courses, and singing schools. Political meetings, health talks by the county nurse, and the annual community fair are held in the building.

The notable advancement which this community has made in nine years is an example of what an ordinary rural community can accomplish if it has a well-planned community building as a focal point for a prepared program of cooperation, under capable leaders, in which the economic and social supplement each other. The pastor said, "We are getting things through cooperation which other communities have not been able to get."

The community building also proves its worth as an effective instrumentality in the program of cooperation which unites several weak and ineffective communities into one large community tending toward the possession of the requisites of a satisfying community life and the ability to accomplish great results.

COUNTY AGRICULTURAL ASSEMBLY HALL

A recent example of the linking of the farmer's economic and social interests in one building is seen at Park River, N. Dak. The territory represented is a large county.

As one of the most important interests of the farmers of Walsh County is the breeding of purebred livestock, many are associated in an influential farm organization, the Northeast Breeders' Association, which has 300 members.

Park River, a town of 1,114 inhabitants, is not the county seat, but it is near the center of the county and is surrounded by stock-breeding farmers. Profits from this industry come largely from livestock sales of a community and county-wide character, and the industry receives its publicity largely through livestock shows and fairs, which have a large attendance of farmers and others interested.

The county agricultural and training school is located at Park River, and there was need for a large gymnasium. A building that would house these activities and various other county agricultural assemblies and meetings, together with the social organizations of the farmers and village people, was wanted. The movement for the erection of the building was led by the breeders' association, and so strong did it become that the county decided to sponsor it.

The building, completed in 1928, is 74 by 148 feet, is one story high, with part basement, and is located on a 3-acre site. (Fig. 21.) Its principal feature consists of the stock-sales room, stock show, and assembly hall with stage, which will seat 3,000 people. Special arrangements were made, including a wide entrance and concrete side and end sloping floors for showing livestock or displaying it for sale and for the seating of the people interested. Movable bleacher seats are used.

In the basement there are a kitchen (furnished with stove, sink, and dumb-waiter), two dressing rooms, and two baths. There is a furnace. In the building are a moving-picture machine and a piano; the building has running water from the town, has forced ventilation, and is lighted by electricity.

The building cost the county $22,800, of which the building alone required $20,000; equipment, $2,000; grounds, $400; and ground improvements and equipment, $200. Money to build it came from general county funds. Control of the building and of the activities connected with it rests with the county commissioners who, in turn, are elected by the people.

During the short time since its erection the building has been used for purebred-livestock sales, shows, and judging contests; for the county midwinter fair and local fairs; for grain shows, seed demonstrations, poultry shows, the meetings of the county economic conference, the northeast North Dakota farm women's camp, the vocational work of the county agricultural school, farm demonstration work, and the boys' and girls' club work. The activities of the breeders' association and other economic organizations center there. It has also been used for county play day, rural school graduating exercises, roller skating, as the meeting place of various social organizations, for moving pictures, local plays, banquets, athletics, gymnasium work, and for those social activities that supplement business meetings and events.

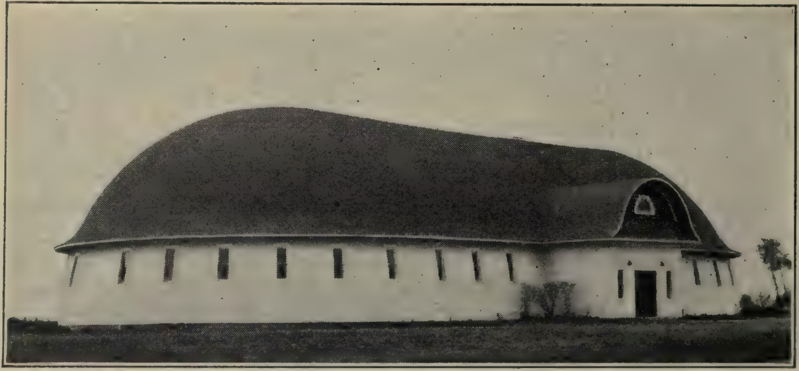


FIGURE 21.—Walsh County Agricultural Assembly Hall, Park River, N. Dak.

It is too early to make final judgment of this particular effort of an agricultural county to center its principal economic and social interests, or of the particular physical arrangements of the building, but the people take great pride in their building, are satisfied with it, and are successfully carrying out the principle of economic and social cooperation.

CONCLUSION

The study made of various community agricultural buildings reveals the increasing appearance of a newer type of structure for common purposes in rural communities. Economic and social interests are being brought together to their mutual advantage. The building is becoming the center of family influence. Community buildings are adopting programs of community economic interest. The organizations responsible for these buildings are cooperating with other rural and town organizations and making their influence felt toward the betterment of the community. The erection and utilization of these buildings tend to develop leadership, promote a cooperative spirit, and increase the size of the communities wherein they are located.

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For sale by the Superintendent of Documents, Washington, D. C. - - - - Price 10 cents

THE GIPSY MOTH AND THE BROWN-TAIL MOTH

By A. F. Burgess, *Principal Entomologist in Charge of Moth Work, Plant Quarantine and Control Administration*

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THE GIPSY MOTH

INTRODUCTION AND SPREAD

IN 1869 a number of egg clusters of the gipsy moth (*Porthetria dispar* L.) were brought from France to Medford, Mass., by a French mathematician and astronomer, who seemed to have had a fanciful idea that he could cross this insect with silkworm moths and thus develop a hardy race of silk-producing insects. In the course of his rearing experiments some of the eggs were accidentally lost or some of the caterpillars escaped, and he made at that time public acknowledgment of this fact, evidently somewhat appreciating the danger.

It is clear now that the insect increased slowly and after 10 years seemed to have been noticed by local residents but was believed to be some native caterpillar. It was not until some 20 years after the introduction, namely, in the summer of 1889, that this insect became so abundant and destructive as to bring it into general public notice. At that time fruit and shade trees in the immediate region were completely defoliated and the caterpillars swarming into the houses became a very grave nuisance. This situation was so serious that the State of Massachusetts appropriated funds and delegated to the State department of agriculture the task of exterminating this pest.

The area that was found to be infested covered about 359 square miles and the trees in many towns surrounding Boston were completely defoliated each season for a number of years. As the work continued, more effective methods of treatment were adopted and better results were obtained; consequently, during the summers of 1898 and 1899 little defoliation could be found in the entire area and few specimens of the moth were located throughout the entire residential sections of the infested district. Careful examination indicated that the insect had been exterminated in some of the towns around the outside border of the originally infested district. In February, 1900, the work was discontinued by the general court because of the popular belief that the danger had passed, in spite of the advice of experts that the insect had not been stamped out.

Within the next five years the insect increased enormously. Many of the towns and cities in the old infested district were overrun with caterpillars which completely defoliated the trees in many of the residential sections and thousands of acres of woodland were stripped of leaves during the summer. The situation became so serious and intolerable that in 1905 control work was resumed by the State of Massachusetts. In the meantime the insect had spread far beyond the original limits of infestation, over 2,224 square miles being involved in Massachusetts as well as a considerable number of isolated areas in Maine, New Hampshire, and Rhode Island.

In 1906 an appropriation was made by Congress and the Secretary of Agriculture was authorized to take all possible measures, in cooperation with the States concerned, to prevent the spread of this pest. The insect had increased to such enormous numbers and had spread so rapidly that the utmost efforts of the Federal and State forces were only able to apply relief measures in the badly infested residential sections and partially retard the continued spread of the pest. Efforts were made to prevent the shipment of the insect to uninfested localities by inspecting products that were likely to carry the insect. This phase of the work was greatly strengthened as a result of the enactment of the plant quarantine law by Congress on August 20, 1912.[1] Since October of that year shipments from the infested district have been regulated by Federal quarantine.

On account of the serious situation that was resulting from the continued spread and increasing damage caused by this insect, efforts were constantly being made to develop improved means of control. The process of manufacturing lead arsenate, which was first made and used in the gipsy-moth work in 1893, was perfected so that the cost of production was reduced and the product could be more effectively applied. Spraying machinery and equipment were developed to a high point of efficiency. Advantage was taken of the results of experimental work in carrying on the field operations, and the details of field management were constantly improved in order that the greatest possible volume of effective work could be done with the funds available.

This pest is distributed by natural means, principally by the newly hatched caterpillars being blown by strong winds when accompanied by high temperatures in the spring. Under favorable conditions such caterpillars may drift a distance of 20 miles.

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[1] This act created the Federal Horticultural Board and gave authority for the establishment of Federal quarantines to prevent the spread of dangerous introduced insect pests and plant diseases. The act making appropriations for the Department of Agriculture for the fiscal year ended June 30, 1929, transferred the functions of this board, together with insect-control activities, to the Plant Quarantine and Control Administration.

In spite of the efforts that were made by the Federal Government and all the States concerned, the insect continued to spread. By 1914 it had covered the southern half of New Hampshire and extended as far east as Bangor, Me. On the west it had crossed the Connecticut River in Vermont and Massachusetts. Rhode Island and many towns in eastern Connecticut were found to be infested.

During the war period conditions were most unfavorable for preventing spread. The loss of efficient personnel and constant turnover of men, together with extraordinary increase in costs, made progress difficult. During this period weather conditions were especially favorable for spread toward the west. By the fall of 1922, colonies were found in many towns in Vermont and west of the Connecticut River in Massachusetts and Connecticut, and an infestation was located in New York State adjoining the Massachusetts State line. Every indication pointed to the continued spread of the insect unless more intensive work could be done.

As a result of this serious situation a conference was held in the office of the commissioner of farms and markets in Albany, December 26, 1922, which was attended by representatives from all the infested States, the Dominion of Canada, and the United States Department of Agriculture.[2] The conference considered the entire subject of the prevention of spread of the gipsy moth and its control, and adopted a resolution urging that sufficient funds be obtained by the States interested and the Federal Government, for the purpose of continuing and strengthening present control methods in the infested area, to do necessary scouting for the discovery and destruction of border infestations, to determine the location of the most practical place for a control zone, to take necessary steps to make control therein effective, and for the destruction of all infestations in and west of said zone.

In order to carry out this project legislation was passed by the State of New York in April, 1923, carrying an appropriation of $150,000 to be administered by the department of conservation of that State. Federal funds were also provided for the fiscal year beginning July 1, 1923, in order to bring about effective cooperation.

The plan finally adopted, in cooperation with the New York Department of Conservation, was to locate a zone east of the Hudson River where clean-up operations would be centered in order to prevent westward spread of this pest. (Fig. 1.) The territory east of this zone was to be treated by the States concerned as far as their funds would permit, and their work was to be supplemented by liberation of imported parasites and other natural enemies of the insect by the Bureau of Entomology. Work in the New York portion of the area was to be financed by the State with such assistance as could be given by the bureau after covering the eastern part of the zone. This zone embraced an area of over 8,000 square miles extending from Long Island Sound east of the Hudson River (excluding

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[2] THE GIPSY MOTH, AN IMMINENT MENACE TO THE FOREST AND SHADE TREES OF THE STATE OF NEW YORK. New York State Dept. of Farms and Markets, Agr. Bul. 148, 58 p., illus. 1922.

Westchester County, N. Y.) to the Canadian border, a distance of over 250 miles, and ranging in width from 25 to 30 miles.

While much of the extremely rugged country in the Adirondack and Green Mountains was avoided in northern New York and in Vermont, as well as the Catskills and some of the rougher country west of the Connecticut River in Connecticut, there are areas, embracing the Berkshire Hills in western Massachusetts and some of the territory directly south and southwest of them in Connecticut and New York, where the terrain is extremely difficult.

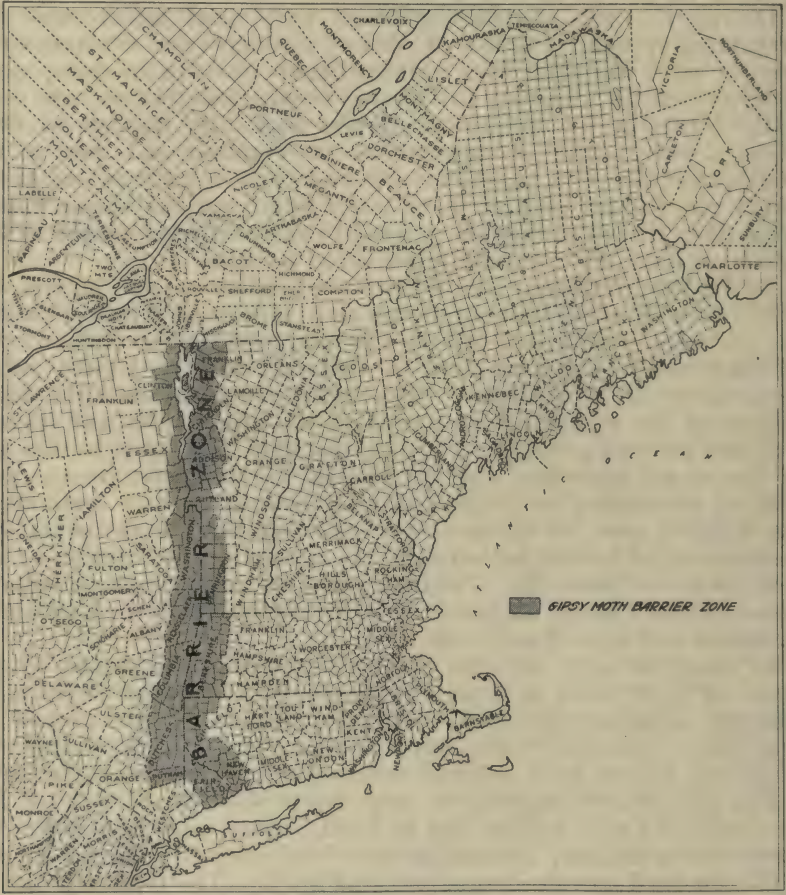

FIGURE 1.—Barrier zone in New England and New York

In 1924, owing to the number of infestations found in Massachusetts and Vermont, and a vigorous colony that was located at Henrysburg, Quebec, by the inspection force of the Dominion entomologists of Canada, the quarantine line was moved westward to embrace the whole of the State of Vermont and additional towns in northwestern Connecticut. A foreign quarantine regulating the movement of Christmas trees was made effective covering the southern tier of towns in the Province of Quebec. (Fig. 2.) Since that time, owing to the effectiveness of the clean-up work in the barrier zone, supplemented by a limited amount of scouting work carried on west of the zone as a precautionary measure, it has been possible to revise the area under quarantine and eliminate the area included in the zone. The Canadian quarantine was withdrawn July 1, 1928. (Fig. 3.)

The danger of reinfestation of the barrier zone depends to a very large extent on the density of infestation east of the zone. The following tabulation indicates the acreage defoliated by the gipsy moth east of the zone from 1924 to 1929, inclusive:

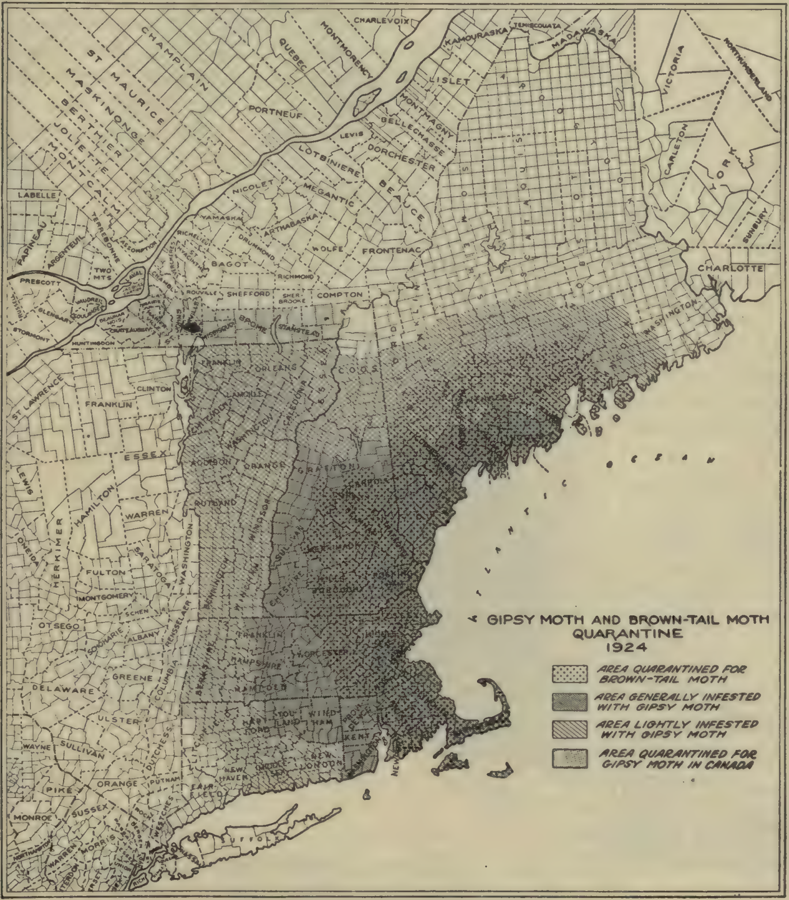

FIGURE 2.—Quarantined areas, 1924

Acreage defoliated by the gipsy moth, 1924 to 1929, inclusive

Year	Acres	Year	Acres
1924	825	1927	140, 920
1925	48, 560	1928	262, 514
1926	80, 822	1929	551, 133

It will be noted that defoliation has been increasing rapidly in the area east of the barrier zone, and during 1928 and 1929 the insect was sufficiently abundant to cause some defoliation between the Connecticut River and the zone area. During the period covered by the tabulation, parasites and natural enemies of the gipsy moth have been scarce in most of the infested area, but in the summer of 1929 an increase was noted. On account of these conditions the control work done by the States and the cities and towns has been confined chiefly to residential sections and to parks and street trees. Very little work has been done in woodland areas. More infestations were found in the barrier zone in 1928 after July 1 than during the entire previous fiscal year, which made the problem of preventing the increase of the insect far more difficult and emphasized the importance of carrying on work in the territory east of the zone in order to make it possible to keep the zone free from infestations. As a result of the increase in infestation directly east of the zone, 7 towns in Vermont, 12 in Massachusetts, and 31 in Connecticut, embracing an area of 1,581 square miles, were added to the generally infested area under quarantine.

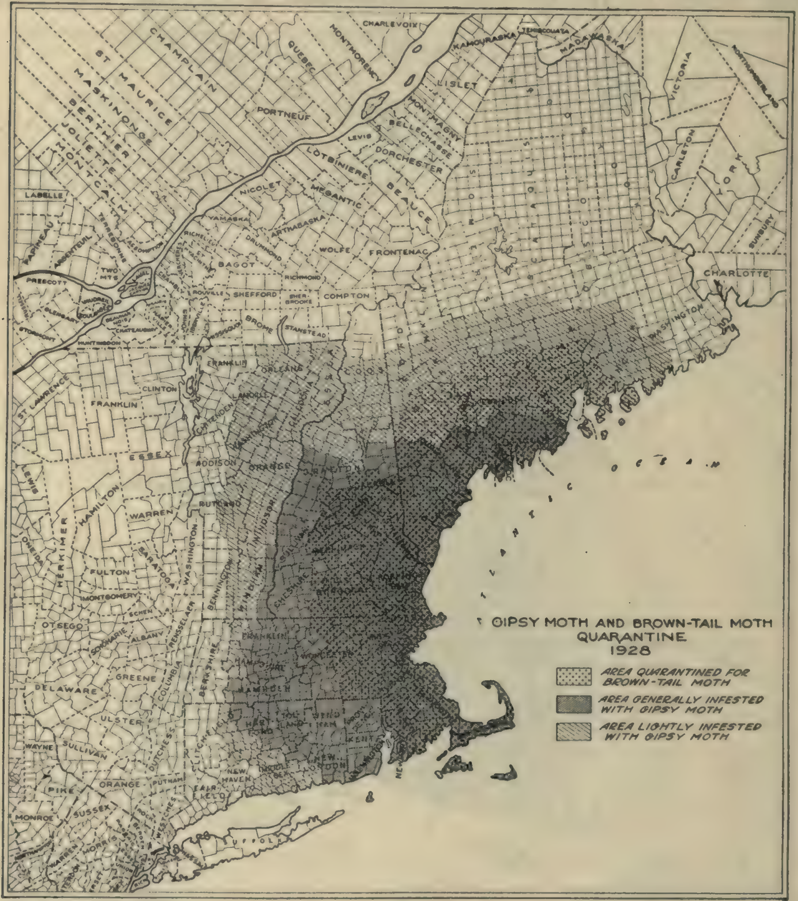

FIGURE 3.—Quarantined areas, 1928

During the latter half of 1929 and the first half of 1930 the number of infested locations continued to increase in the barrier zone and additional funds were made available by Congress to carry on clean-up work. No action was taken, however, to provide for the examination of territory immediately east of the zone from which most of these infestations originated and which furnish a source of constant supply of the insect so long as they remain untreated. The scouting work during the fall of 1929 and spring of 1930 resulted in the discovery of an increasing number of infested locations, although practically all of those found in previous years had been exterminated. Serious infestations were found in Branford, Middlefield, and Meriden, Conn., and Chester, Mass., towns immediately adjoining or close to the barrier zone line to the east. These colonies will be treated by the States concerned. Three of these colonies are in heavy woodland, and as no scouting work is done in woodland in most of the towns which border the barrier zone on the east, there is every probability that more infestations of this nature are present which, if allowed to remain untreated, will cause constant reinfestation of the areas that are being cleaned up.

Since the barrier zone was established, large areas immediately adjoining the zone on the west have been examined and two small infestations found and eradicated. Thus far the work in the barrier zone has accomplished its purpose, namely, the prevention of spread of the insect to the west and the extermination of the colonies as rapidly as they are located within the zone area.

RECORD OF CLEAN-UP OF OUTLYING GIPSY-MOTH COLONIES

In 1912 a small area was found heavily infested with the gipsy moth in Geneva, N. Y. Prompt action was taken by the State department of agriculture, and the Federal Bureau of Entomology cooperated. Clean-up measures were applied. Several very thorough annual examinations have been made but no trace of the insect has been discovered. In February, 1914, a colony was discovered at Bratenahl, a suburb of Cleveland, Ohio. Immediate attention was given this colony by the Bureau of Entomology in cooperation with the Ohio Department of Agriculture. As a result of thorough inspection and treatment work for three seasons, the colony was exterminated. In May, 1914, a colony was found by State inspectors in North Castle, Weschester County, N. Y. The infestation was heavy at the center and scouting determined that it extended over about 1 square mile. Intensive work was done throughout this area and the surroundings by the State and Federal forces, and although the locality was a very difficult one to treat thoroughly, the moth was exterminated. In the same year a small colony was exterminated at Rutherford N. J., by the Bureau of Entomology. In June, 1921, a small infestation was found at Greenport, near the east end of Long Island, N. Y., and during July another was reported at Patchogue on the south side of the island. The Bureau of Entomology, in cooperation with the State department of farms and markets, exterminated the insect in these colonies. Since that time several small infestations have been found on Long Island and have been exterminated by the New York State Department of Conservation. (Fig. 4.)

GIPSY-MOTH EXTERMINATION PROJECT IN NEW JERSEY

Early in July, 1920, the gipsy moth was found on a large estate near Somerville, N. J., by one of the State inspectors. The infestation centered in a large plantation of blue spruce trees, several acres of which were defoliated. Dead trees in the worst infested portion indicated that they had been killed as a result of defoliation and that the infestation was one of long standing. (Fig. 5.)

These trees had been imported from Holland about 10 years before, and there is no doubt that the infestation came with this shipment, which was received prior to the enactment of the plant quarantine act. This shows clearly the pressing need for precautionary measures to keep out dangerous pests.

Scouting work carried on during the fall of 1920 and spring of 1921, financed by the State of New Jersey and the Federal Government, revealed infestations of this insect in scattered localities in an area of over 400 square miles surrounding Somerville.

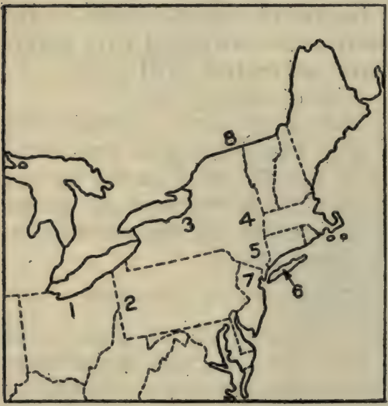

FIGURE 4.—Map showing locations, outside of the large New Jersey infestation and the barrier zone, where the gipsy moth has been exterminated: 1, Cleveland (Bratenahl), Ohio; 2, Loretto, Pa.; 3, Geneva, N. Y.; 4, Schenectady, N. Y.; 5, North Castle and Garrison, N. Y.; 6, Brooklyn, Roslyn, Kew Gardens, and Greenport, on Long Island, N. Y.; 7, Deal Beach, Wyckoff, South Orange, Scotch Plains, Paterson, Madison, Glen Rock, Elizabeth, and Rutherford, N. J.; 8, Henrysburg, Quebec, Canada

Previous successes in cleaning up local infestations led to the adoption of a cooperative plan to clean up this large, newly discovered infestation. State and Federal funds were appropriated, and the work was organized under the direction of the field office for gipsy moth control of the Bureau of Entomology. When the limits of infestation had been determined, the area was placed under State quarantine, which required, as a condition of movement from the infested area, certification as to freedom from infestation of all products likely to carry any stage of the gipsy moth. Thorough inspection which permitted certification was done in cooperation with the Federal Government and by Federal inspectors. The area under regulation has been gradually reduced as the results of the clean-up work have made this possible.

As soon as active work was under way in New Jersey it was discovered that trees had been shipped during the preceding years from the estate where the insect was first located and that the danger of the establishment of the insect in many localities was very great. Fortunately a record of all these shipments was available. It was found that 261 shipments had been sent to the District of Columbia and to 15 States outside of New Jersey as follows: Connecticut, Delaware, Florida, Illinois, Indiana, Kentucky, Maryland, Minnesota, Missouri, New York, North Carolina, Ohio, Pennsylvania, Virginia, and Wisconsin. These shipments were traced and inspections made of the planted stock by State or Federal officials. In addition to this, 318 shipments had been distributed in New Jersey, and these were followed up in the same way.

As a result of this work small infestations were found at Loretto, Pa., Garrison, Roslyn, and Kew Gardens, N. Y., and Deal Beach, Wyckoff, South Orange, Scotch Plains, Paterson, Madison, Glen Rock, and Elizabeth, N. J. Thorough work cleaned up these small infestations during the following year, and repeated scouting has failed to indicate the presence of the pest.

In the meantime intensive work was carried on in the central part of the infested area, and more than 3,000,000 egg clusters were treated the first season. The trees on several acres were not only completely defoliated at the time the colony was discovered, but many were dead and others were in a dying condition. This intensive work prevented defoliation the following season; in fact, no trees have suffered from gipsy-moth feeding in New Jersey since that time. During the next four years the scouting and clean-up operations were continued throughout the entire area known to be infested, particular attention being paid to a series of extensive woodland areas north of Somerville, known as the Watchung Ridges. These areas were by far the most difficult and expensive part of the territory to handle properly, as many square miles of woodland were involved. Substantial progress was made as the work proceeded. The density of the infestation in 1921 is indicated on the map in Figure 6.

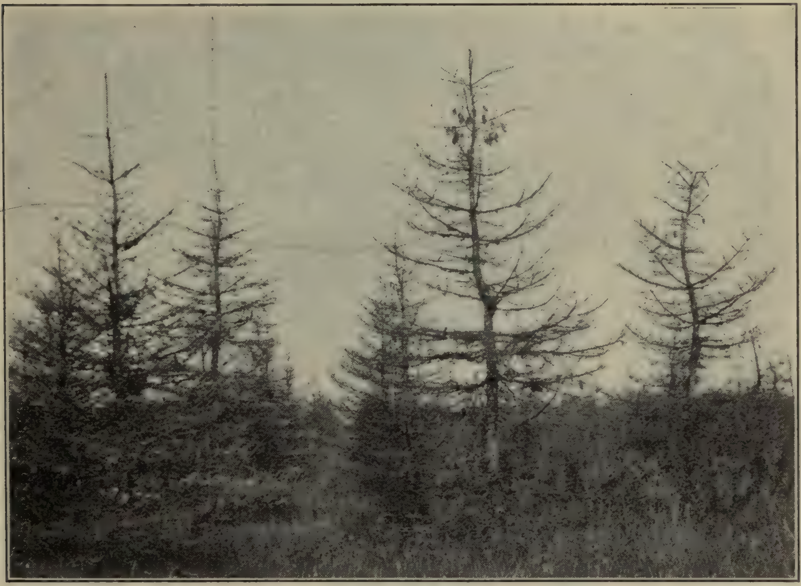

FIGURE 5.—Blue spruce defoliated and killed by the gipsy moth

Since 1925 continuous progress has been made in cleaning up and exterminating the gipsy moth in New Jersey. It has been necessary to operate in an area embracing 2,369 square miles, and the towns in the area where colonies have been found cover 924 square miles.

The area in which intensive scouting is necessary has been reduced to 197 square miles. (Fig. 7.)

LIFE HISTORY OF THE GIPSY MOTH

In the course of its life the gipsy moth passes through four stages—the egg, the larva or caterpillar, the pupa, and the adult or moth. (Fig. 8.)

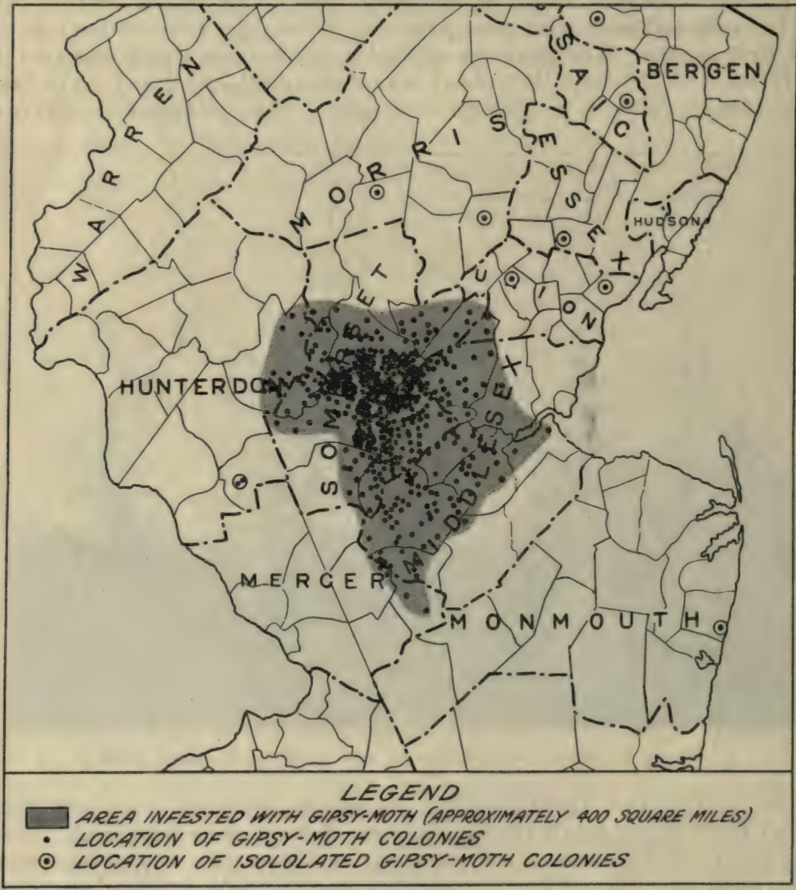
WARREN
MORRIS
BERGEN
ESSEX
HUDSON
UNION
HUNTERDON
SOMERSET
MIDDLESEX
MERCER
MONMOUTH
LEGEND
▨ AREA INFESTED WITH GIPSY-MOTH (APPROXIMATELY 400 SQUARE MILES)
• LOCATION OF GIPSY-MOTH COLONIES
⊙ LOCATION OF ISOLOLATED GIPSY-MOTH COLONIES

FIGURE 6.—Map showing area in New Jersey infested by the gipsy moth in 1921, indicating the density of infestation and location of isolated colonies

THE EGGS

The female gipsy moth deposits a cluster containing 400 eggs or more, which she covers with buff-colored hairs. Most of the egg clusters are laid during July and hatch about the time the leaves begin to appear the following spring. They are deposited on the under side of branches of trees, on tree trunks, under loose bark, or in cavities in the trunks or branches, and are sometimes placed on stones or rubbish and in a variety of situations where they are concealed from view. As the female moths do not fly, egg clusters are seldom found far from the food plant upon which the caterpillars developed.

THE LARVAE

The newly hatched larvae feed on the opening leaves, making small perforations. They grow rapidly and become full fed early in July. During this period they molt five or six times, and as they increase in size they eat a larger proportion of the foliage, so that, if the infestation is severe, trees may be stripped completely of foliage before the end of June.

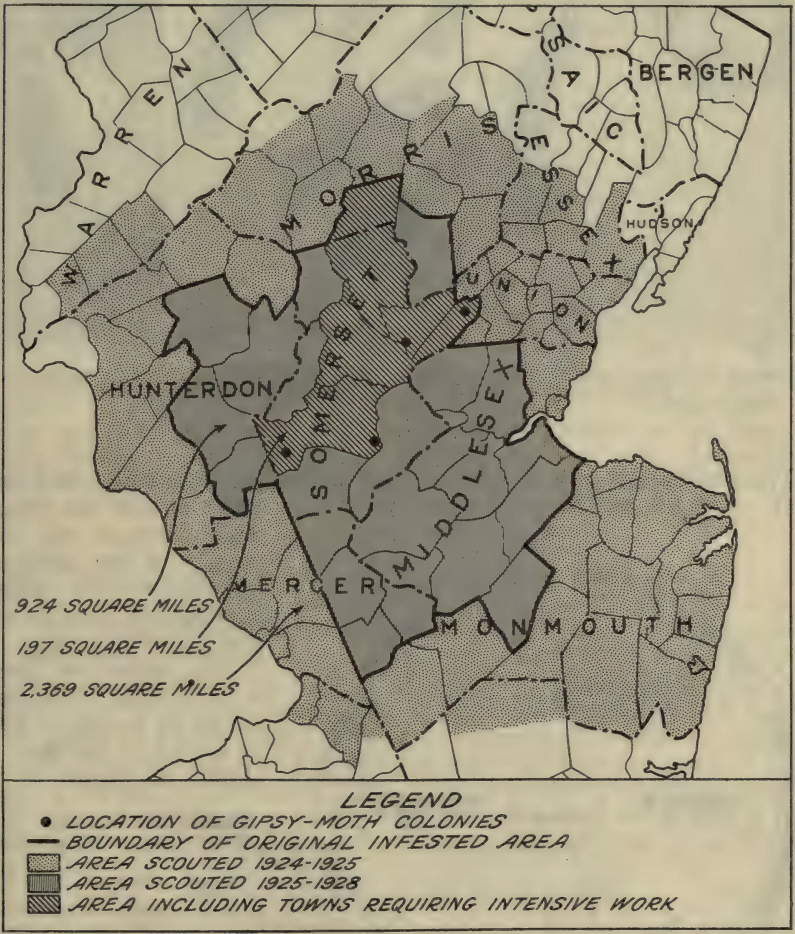

FIGURE 7.—Map showing conditions of infested area in New Jersey in 1928, indicating colonies and reduced area requiring intensive work

THE PUPAE

When full grown, the caterpillars shed their skins and transform to pupae, which are chestnut brown and provided with tufts of yellow hairs. They remain in this stage about 10 days, after which the adult insects emerge.

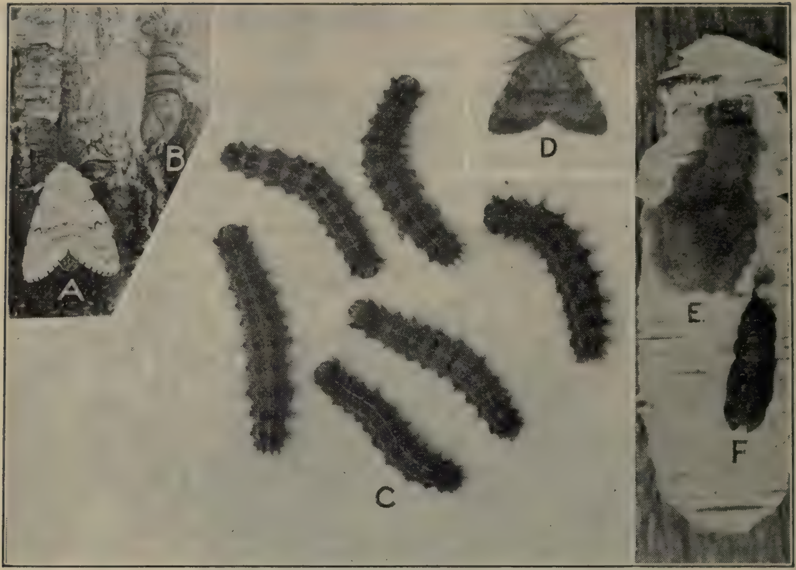

FIGURE 8.—Life stages of the gipsy moth: A, Female moth; B and F, pupae; C, larvae or caterpillars; D, male moth; E, egg mass. All about three-fourths natural size

THE ADULTS

The male moth is dark brown, with black wing markings, and flies well. The female is nearly white, with black markings on the wings, and because of the weight of the abdomen she does not fly. After mating, the females begin depositing eggs.

The time of year when the different forms of the insect may be found in the field is shown in Figure 9.

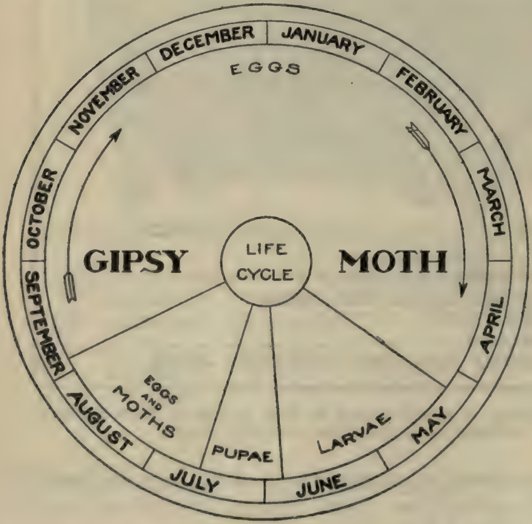

FIGURE 9.—Time of year when the different stages of the gipsy moth are present in the field

MEANS BY WHICH THE GIPSY MOTH IS SPREAD

Egg clusters of the gipsy moth deposited on trees, lumber, stone, or other products that are likely to be shipped, may be carried long distances and cause the establishment of new colonies of the insect. Spread in this way is prevented by inspection of such products before they are shipped. Caterpillars of this insect may be spread for limited distances by being carried on moving objects, such as trains, horse-drawn vehicles, or automobiles. The danger of such spread is very slight if the roadways are kept free from severe infestation. New colonies are started principally by the spread of newly hatched caterpillars. Experiments have shown that these caterpillars may be blown by the wind, if the temperature is high enough for the caterpillars to be active, and the stronger the wind the greater the probability of their being carried long distances. Caterpillars have been carried more than 20 miles in this way, and specimens have been caught in the air 50 feet above the ground, although probably they are carried much higher in the air. The temperature must range above 65° F. and the wind velocity must be 8 miles or more per hour, in order that spread of small caterpillars by wind may result.

In recent years a new avenue for spread of the gipsy moth has developed from the extensive use of the motor truck for long-distance hauling. Fortunately the material hauled is only occasionally of a dangerous nature, but chance of spread in this way is more or less constant.

The popularity of automobile camping parties presents another source of danger, particularly during the vacation season. There is a growing tendency, however, to restrict such camps to municipal or semipublic grounds. Under these conditions the danger can be minimized by proper inspection. Warning posters are being used in sections where parties are likely to camp, instructing them to examine their effects carefully so that no caterpillars or egg clusters of the insect will be carried away. Many camps in the heavily infested area are inspected annually.

FOOD PLANTS OF THE GIPSY MOTH

The food plants most favored by the gipsy moth are apple, the different species of oak, gray birch, alder, and willow. In cases of bad infestation nearly all deciduous trees are injured to a greater or less extent, with the exception of ash. Hickory is not a favored food plant, although the foliage occasionally shows severe feeding. Chestnut will not support the gipsy-moth caterpillars when in the first stage, and pine will not support them in the first two stages; but if other food plants are present severe injury may result from feeding by the larger caterpillars. Beech and poplar are sometimes fed upon freely, and occasionally the trees are defoliated. The different species of spruce are more susceptible to attack than the pines.

INJURY CAUSED BY THE GIPSY MOTH

Unless reduced in numbers by natural enemies, unfavorable climatic conditions, or the application of control measures, the gipsy moth is capable of causing enormous injury to tree growth. In the area of New England which has suffered most from this insect thousands of trees have been killed as a result of defoliation. (Fig. 10.) On many areas the trees were cut before they were mature and the wood sold at a loss on account of damage caused by the insect. Apple and oak have been injured most, but pine and other coniferous trees mixed with deciduous growth have suffered severely. (Fig. 11.)

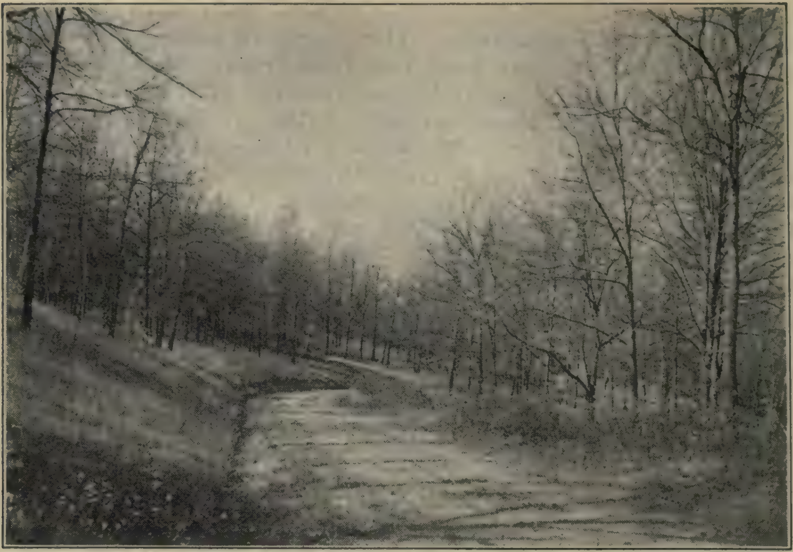

FIGURE 10.—Deciduous trees defoliated by the gipsy moth

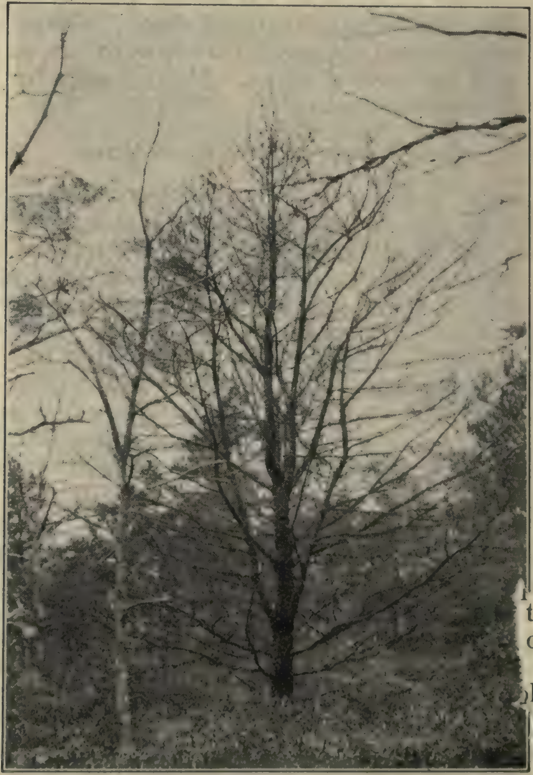

FIGURE 11.—White pine, in a mixed growth, defoliated by the gipsy moth

Many oak trees which have been weakened severely as a result of defoliation by the gipsy moth and the brown-tail moth have failed to recover because of the attacks of certain wood-boring insects. The species which has caused most damage in this way is a beetle (*Agrilus bilineatus* Weber) known as the two-lined chestnut borer, the larva of which feeds beneath the bark of injured trees.

EFFECT OF CLIMATIC CONDITIONS ON THE GIPSY MOTH

Investigations have shown that extremely low temperature during the winter is fatal to eggs of this insect that have been deposited in exposed situations. From −20° to −25° F. is usually required to injure them sufficiently to prevent hatching, and if the clusters are protected by snow, ice, or other material, the eggs are not killed even at this temperature. After extremely cold winters many eggs fail to hatch. Evidence also indicates that abnormally early frosts in the fall injure freshly deposited egg clusters.

During May, when the caterpillars are hatching, there are sometimes long periods of cold weather accompanied by heavy rains. This condition, or the occurrence of severe frosts in June, occasionally causes the death of the least hardy caterpillars.

NATIVE ENEMIES OF THE GIPSY MOTH

Few insect enemies of the gipsy moth native to New England cause any noticeable reduction in its numbers. This is shown by the fact that from 1900 to 1905, when no systematic effort was made to suppress the insect, alarming injury resulted, and native insect enemies did not increase to any marked degree. The same is true of the work of native insect-eating birds. While they undoubtedly feed to some extent on gipsy-moth caterpillars, there is no case on record where they have been able to control the insect. The " wilt," a disease which attacks and kills the caterpillars and pupae, has probably occurred in this country for many years. During some seasons, particularly in badly infested areas, it causes the death of an enormous number of the caterpillars and is often an important factor in reducing the infestation locally. As a rule, this disease is more common in heavy infestations, where overpopulation of caterpillars causes a scarcity of food.

INTRODUCED PARASITES AND ENEMIES

In 1905 an effort was made by the State of Massachusetts, in cooperation with the Bureau of Entomology, United States Department of Agriculture, to introduce the parasites and natural enemies of the gipsy moth from its native home in Europe and Japan. Since that time a large amount of parasitized material has been received nearly every year, and as a result some promising natural enemies have become established in this country and are assisting in bringing about the control of the species. The enemies which have become established and are at present destroying the largest number of gipsy-moth caterpillars and pupae are the Calosoma beetle (*Calosoma sycophanta* L.), two species of parasitic flies (*Sturmia scutellata* Desv. and *Compsilura concinnata* Meig.), one of which attacks the brown-tail moth as well as caterpillars of many native insects, and two species of small wasplike flies (*Apanteles melanoscelus* Ratz. and *A. lacteicolor* Vier.), one of which likewise attacks the brown-tail moth. Two tiny parasites of the gipsy-moth eggs have also been introduced and colonized, one (*Oencyrtus kuvanae* How.) from Japan and the other (*Anastatus disparis* Ruschka) from Europe.

Several other parasites have been introduced and are established in this country; however, they have not increased sufficiently to be considered important factors in gipsy-moth control. Some additional parasites have been imported during the last three years, but their value has not yet been fully demonstrated.

The work of the natural enemies of the gipsy moth, including the imported parasites, the Calosoma beetle, and the wilt disease, has greatly reduced the numbers of the insect in many localities that are badly infested.

It is hoped that when the enemies of the moth are present in larger numbers over the entire infested territory the insect will become much less destructive than at present.

The records at the gipsy-moth laboratory at Melrose Highlands, Mass., indicate that the species of parasites introduced prior to 1923 increased gradually in the field until 1923, when they reached their greatest abundance, and the results of their work were very noticeable over much of the infested area.

In 1924 the gipsy moth was rather scarce, and parasitism was low; the following year it was still low and did not increase much in 1926. In 1925 the gipsy moth began to increase rapidly in the older infested area, and although some of the parasites gained slightly in 1927 and 1928 they did not prevent the rapid increase of the moth.

Until the natural enemies demonstrate greater effectiveness throughout the entire infested area it will be necessary to employ the best mechanical methods for restricting the spread and curtailing the increase of the gipsy moth. In the meantime further work is being done in foreign lands, particularly in central Europe and the Mediterranean countries, to determine the principal factors that are responsible for the periodical scarcity of the insect there and to take advantage of this knowledge for the purpose of developing more effective natural control in this country.

METHODS OF CONTROLLING THE GIPSY MOTH

GENERAL METHODS

Creosote.—One of the best methods of controlling the gipsy moth is to treat the egg clusters of the insect between August 1 and April 1 with creosote to which a small quantity of lampblack has been added. The material is sold by dealers in the infested region under the name of gipsy-moth creosote. It is applied with a brush and leaves a black residue on the clusters treated. Creosote may be obtained from nearly all the large hardware or seed stores in the infested district.

Burlap bands.—Gipsy-moth caterpillars usually seek shelter during hot, sunny days, and if a band of burlap is attached to a tree (fig. 12), large numbers of them will crawl beneath it, where they may be crushed each day. Ordinarily a strip of burlap about 8 inches wide is placed loosely around a tree trunk and a piece of twine is passed around the center and tied to hold it in place. After this is done the top part of the burlap is folded down so that a double shelter is made beneath it. The extensive use of these bands has been discontinued during the last few years, owing to the expense involved and because of the fact that if the burlap bands are applied early in the season, before the brown-tail moth caterpillars have pupated, an excellent place is furnished for these poisonous caterpillars to make their cocoons, and severe poisoning results to the workmen. If this method is to be used in areas where the brown-tail moth is abundant, the burlap should not be attached to the trees until after June 15, when most of the brown-tail moth caterpillars will have pupated.

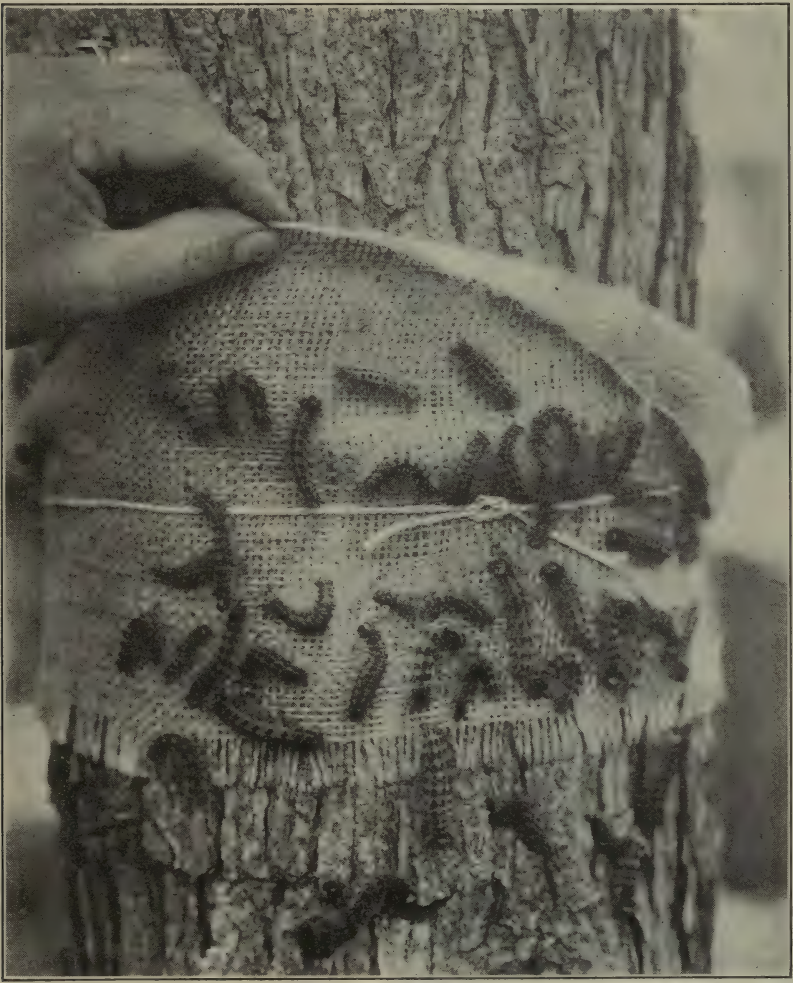

FIGURE 12.—Burlap band on tree with caterpillars beneath it

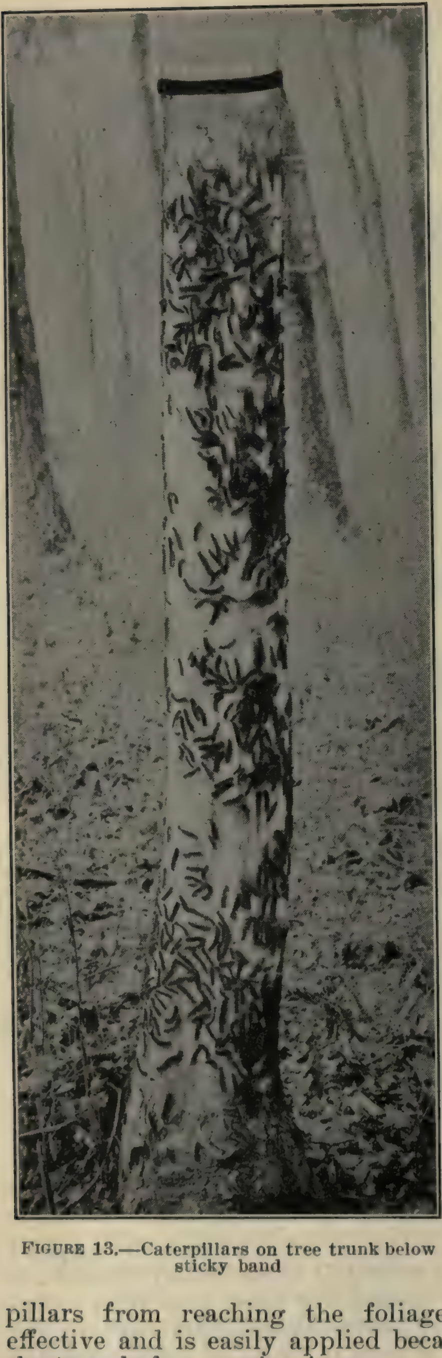

FIGURE 13.—Caterpillars on tree trunk below sticky band

Sticky bands.—Bands of a widely known sticky substance for tree banding, which may be obtained on the market, may be used on tree trunks after the bark has been scraped so that the material can be applied evenly in a thin layer with a paddle. The purpose of this band is to prevent caterpillars from ascending the trees, and if the egg clusters have previously been treated, this is a very effective measure. Every week or 10 days during the caterpillar season a comb or other similar implement should be run over the band in order to prevent hardening of the surface and to bring up fresh, sticky material from the part of the band near the bark. (Fig. 13.) Placing these bands on the trees prevents the caterpillars from reaching the foliage; and as they usually mass in large numbers beneath the bands, conditions are favorable for wilt disease to develop, and the caterpillars often die in large numbers from this disease and from starvation.

Gipsy moth tree-banding material.[3]—This is a black, greasy substance which was prepared and tested by the Bureau of Entomology in cooperation with the Bureau of Chemistry. It is similar to the product known as "Raupenleim" that has been used in the German forests for many years to prevent injury to the trees by caterpillars. It is applied with a special "gun" designed for the purpose. (Fig. 14.) The thick, narrow band left on the tree trunk prevents the caterpillars from reaching the foliage. This material is cheap and effective and is easily applied because it is not necessary to scrape the trees before putting it on.

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[3] For full information concerning the preparation and use of this tree-banding material, apply to the gipsy-moth laboratory of the U. S. Department of Agriculture at Melrose Highlands, Mass.

Spraying.—The most effective spray material for the gipsy moth is lead arsenate. It can be used either in the paste or powder form. More effective control is possible if a sticker is used in the spray. Fish oil or raw linseed oil is excellent for that purpose, as it binds the insecticide firmly to the foliage so that it is not removed by rain or heavy dew.

If either of these stickers is used the quantity of poison can be reduced from 12½ pounds to 10 pounds of paste lead arsenate or from 6¼ pounds to 5 pounds of powdered lead arsenate to each 100 gallons of water. Fish oil is cheaper than linseed oil and is therefore to be preferred. Four fluid ounces of the oil is required for each pound of poison used; in other words, 1¼ pints of oil for 5 pounds of powder or 10 pounds of paste.

In preparing the spray mixture, add the oil after the poison is well mixed with water in the tank and while the whole is being agitated. Continue the agitation while the spray is being applied. The best grade of fish oil, known as "light pressed," should be used, as the cheaper grades are not so satisfactory.

Warning.—It is not safe to allow cattle to graze beneath trees after the spray has been applied. When there is danger of the spray drifting on buildings they should be drenched with water before and after the trees are treated. A garden hose can be used for this purpose. If the spray is allowed to dry, it will disfigure the painted surface. Spraying fruit trees with this mixture is not recommended if the fruit is more than half grown, as it is difficult to remove the spray residue.

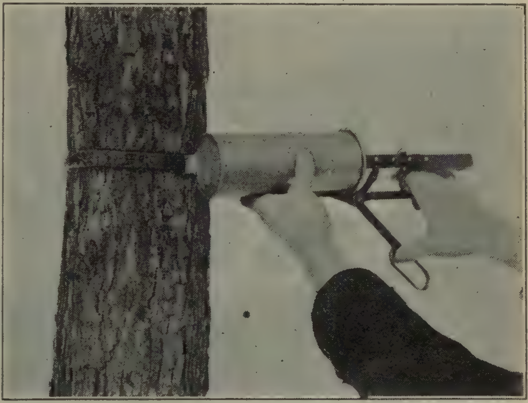

FIGURE 14.—Applying tree-banding material to protect the foliage from gipsy-moth caterpillars

For small operations the ordinary orchard sprayer may be used with one or more lines of hose, depending on the pressure that is available. Nozzles of the Vermorel or Bordeaux type are satisfactory.

In case large shade trees or valuable park or woodland trees are to be treated, the use of a high-power sprayer is more economical. The type that has given the most satisfactory results in the gipsy-moth work develops sufficient power to throw a solid stream of spray so it will drift through the trees. (See illustration on front cover.) The nozzle is constructed so that the stream will break into a fine mist high in the air, and this results in very satisfactory and rapid work. With such a sprayer it is unnecessary to use a small hose and climb trees, which is a slow and expensive operation.

A satisfactory high-power sprayer for this work is equipped with not less than a 10-horsepower gasoline engine and a triplex pump capable of delivering at least 35 gallons of liquid per minute at a pressure of at least 300 pounds. This machinery, together with a 400-gallon tank, should be mounted on a well-built truck. (Fig. 15.) High-grade 1-inch spray hose is required, and a nozzle pressure of 300 pounds or more is necessary, depending on the length of the hose and the elevation of the nozzle above the level of the sprayer. Machines that will develop 1,000 pounds working pressure are necessary in rough country where extremely long lines of hose are required. A machine of this capacity equipped with high-pressure hose will supply a hose line 5,000 to 6,000 feet in length and spray satisfactorily at an elevation of 600 feet above the level of the sprayer.

By using a small device, which is attached to the nozzle and is known as a spreader, it is possible to spray low growth very satisfactorily. Fruit trees can be treated very rapidly in this way. (A nozzle equipped with spreader is shown in operation at the left of the picture on front cover.)

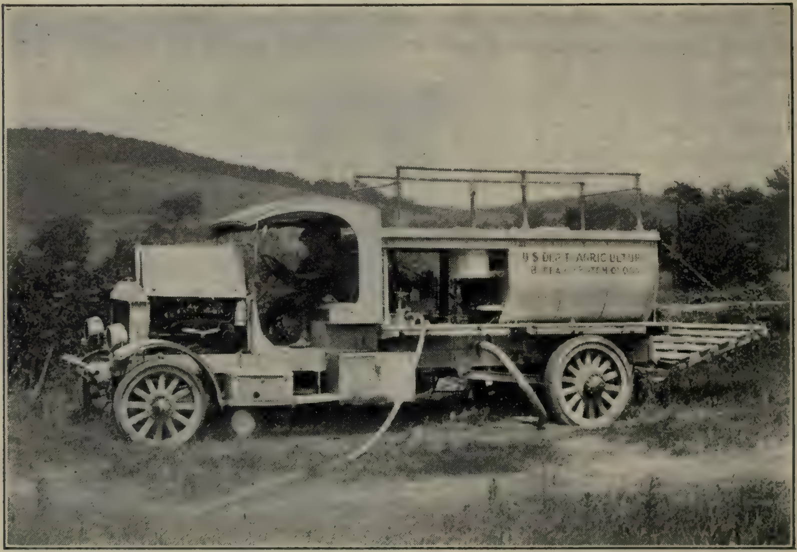

FIGURE 15.—High-power truck sprayer

Tests have been made for several seasons with airships of both the heavier-than-air and lighter-than-air type, to determine whether infested woodland areas could be dusted satisfactorily and economically by these means. This method has not proved entirely satisfactory for use on forest growth. The cost is high, and the dust does not adhere as well as liquid spray when an adhesive like fish oil is used. For certain low-growing crops that have a high annual value this method has given excellent results in some sections of the country.

METHODS TO BE USED IN ORCHARDS

The methods to be used for controlling the gipsy moth in orchards depend largely on the severity of the infestation. If only a few egg clusters are present in the orchard, the early spraying which is applied for the codling moth after the blossoms fall will be found useful, provided the quantity of lead arsenate used is increased to 10 pounds of paste, or 5 pounds of powder, to 100 gallons of water. This spray should be especially effective if fish oil is added. If the infestation is more serious, a second spraying early in June, with a similar quantity of poison, but without fish oil, will be found very satisfactory. Where the infestation is severe, it will probably be necessary to creosote egg clusters in the winter and spray in the spring. Thoroughness is a prime essential if good results are to be obtained. All poor or hollow trees should be removed; and if badly infested woodland is near by, the orchard trees should be banded.

Orchard infestations can be managed by following these methods, and it will not require much additional expense or a great deal of extra work to protect the trees. In making this statement it is assumed that the orchard is being cared for by up-to-date methods to protect it from the codling moth and other injurious insects and diseases, and it is not likely that these results can be brought about in neglected orchards or where the owners do not practice the best horticultural methods in handling their growing trees.

METHODS ADVISABLE IN CITIES AND TOWNS

The same methods that are used in orchards are applicable in cities and towns and for the treatment of park and shade trees. In certain instances it would probably be advisable to use tree-banding material or burlap, preferably the former, and to discontinue spraying in cases where the infestation is very light. If the infestation is bad, creosoting, banding, and spraying should all be used in their season, in order to bring the insect under control and reduce the numbers present to a minimum.

In town or city work careful attention should be given to near-by woodlands or isolated trees, particularly if they are located on high elevations immediately outside the residential area, as colonies in such locations may furnish a supply of caterpillars which will be distributed by wind throughout the town after it has been cleaned. In lightly infested woodland areas spraying may be used exclusively for control, but when heavy infestations exist, a combination of the most effective measures is usually necessary.

The method of handling the gipsy moth in any town, city, or park, or on private estates, should be based on the degree of infestation as determined by some one who is familiar with gipsy-moth work, if the best results are to be secured at a minimum expense. Much energy and money may be wasted in applying remedies unless their application is based on a thorough knowledge of exisiting conditions. An owner of an infested estate should have an examination made by some qualified person who can give reliable recommendations as to treatments. It should be borne in mind that conditions as to infestation vary from year to year, and this should be considered when plans for treatment are being made.

CONTROLLING THE GIPSY MOTH IN WOODLAND

Satisfactory control of the gipsy moth in woodland by the employment of hand methods such as have already been mentioned is impracticable under present conditions, unless the tree growth is particularly valued for purposes other than lumber. If the woodland is situated near a large city and occupies space that is likely to be utilized in a few years for building lots, considerable money may be expended to advantage in protecting the trees, as these will make the property much more valuable when the land is subdivided. Limited areas of woodland on private estates may be of sufficient value to the owners to justify a considerable expenditure for moth destruction. In all cases, however, the species of trees involved should be carefully studied before a plan of work is adopted, in order that the expense may be reduced as much as possible. Unfortunately the difficulty of treating the woodlands in the infested area of New England is considerably increased by the fact that they are for the most part composed of numerous species in mixture.

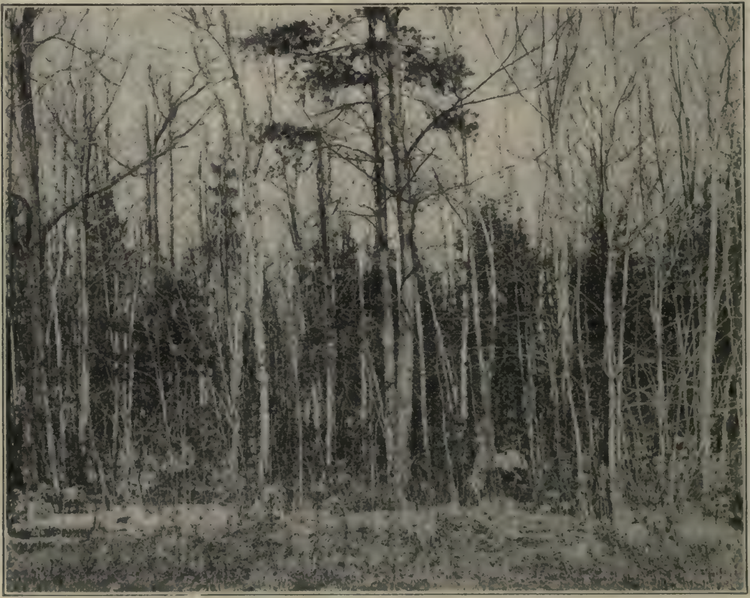

FIGURE 16.—Mixed deciduous and coniferous woodland before thinning

Experiments have shown that most coniferous trees are not injured by the gipsy moth if grown in isolated pure stands; and if the growth is such that the trees can be thinned to a stand of immune species, no hand suppressive measures are necessary in order to prevent injury by this insect. Such lots will not be attacked by the brown-tail moth, as the larvae of this insect do not feed on conifers.

If mixtures containing a large percentage of deciduous trees are to be protected from moth injury, the species involved should be carefully considered before a decision is reached as to the best methods of treatment. Sometimes practical methods of thinning (figs. 16 and 17) can be adopted so that species will be left that are only slightly subject to injury by these insects. Experiments have shown that mixtures of chestnut, pine, red maple, ash, and hickory, regardless of the proportion of each species, are seldom injured by the gipsy moth.

In woodlands the oaks are the most favored food plant of this insect, and, unfortunately, the infested region abounds in large areas where these species predominate. At present there seems to be no method aside from hand treatment which will prevent serious injury to oak woodland, but as a large part of such land consists of poor sprout growth, the amount of damage sustained is not always so great as it might at first appear. The greatest injury likely to be caused in such areas where oaks and gray birch abound is the dying of small pines or other valuable species which have been denuded by the caterpillars after the oaks and birches have been defoliated. This reduces greatly the chance that the sprout growth will be replaced by any species of value that can withstand gipsy-moth attack. Consideration is being given to devising some economical method for protecting and improving wood lots of this character at moderate expense. It is true that in considerable areas of oak woodland the trees, although not mature, could be utilized for small timber, railroad ties, or cordwood, and in cases of bad infestation such woodland should be promptly cut if the wood can be sold to advantage. On cheap cut-over or infested lands in many sections of the territory white or red pine might be planted to advantage, but as this involves considerable expense and as the crop can not be harvested for a period of years, the question of the desirability of managing any wood lot in this way must, in the end, be decided by the owner of the property.

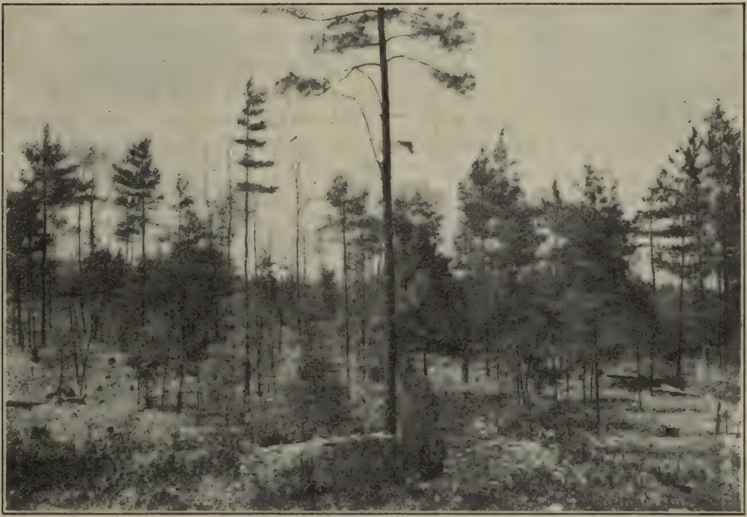

FIGURE 17.—Same woodland after growth favored by the gipsy moth has been removed by thinning

If the practice common in some European countries of maintaining municipal or state forests were well developed in the New England States, it would be possible in a period of years to transform considerable areas of land which are now destined to be worthless, and which form a favorable feeding ground for the gipsy moth, into well-managed forests of valuable growth.

THE BROWN-TAIL MOTH

INTRODUCTION AND SPREAD

The brown-tail moth (*Nygmia phaeorrhoea* Don.) was first found in the United States in Somerville, Mass., in the summer of 1897, and was undoubtedly introduced several seasons previous to that time on imported nursery stock. The insect increased enormously, and as the caterpillars were particularly fond of the foliage of fruit and ornamental trees and shrubs, they became an unbearable nuisance, particularly in residential sections. Not only was complete defoliation common in early summer, but as the hairs from the caterpillars caused serious poisoning to human beings, the presence of this pest became a veritable scourge in densely populated sections. The insect extended its range very rapidly because the moths of both sexes fly freely. This species occurs in many sections of Europe and is frequently seriously injurious.

The State of Massachusetts applied suppressive measures from the winter of 1897 until February, 1900, when this work was discontinued as was the case with that against the gipsy moth. By 1905, when work on the gipsy moth was resumed, the brown-tail moth was extremely abundant in eastern Massachusetts. It was also present in enormous numbers in Rhode Island, southern New Hampshire, and southeastern Maine. Not only did fruit and shade trees suffer defoliation, but large areas of oak woodland, particularly sprout growth, was completely defoliated.

The insect continued to spread until 1915, when most of the area east of the Connecticut River, with the exception of a portion of northern New Hampshire and Maine, was heavily infested. Some infestation also existed in Vermont and west of the Connecticut River in Massachusetts and Connecticut. Suppressive work was carried on by the States and the Federal Government and the residential sections were kept fairly free from this pest.

The area now infested by the brown-tail moth is shown in Figure 3, and is much less extensive than the maximum limits to which it had previously spread. Unfavorable winter conditions, particularly in the northern part of the territory, coupled with the work of natural enemies and disease and the continuous repressive measures used in the residential sections, have caused a remarkable decrease in the abundance of this pest. The insect has been found in Nova Scotia and New Brunswick, but the area of the infested territory has been greatly reduced there and it is only moderately abundant at the present time in sections of Nova Scotia.

This pest can easily be shipped on woody plants, but general spread in this manner has been prevented by the strict enforcement of inspection and quarantine regulations.

LIFE HISTORY OF THE BROWN-TAIL MOTH

The different stages in the development of the brown-tail moth are shown in Figure 18.

THE EGGS

The female moth deposits a small cluster of eggs on the underside of a leaf. They are usually laid in July, and are covered with brown

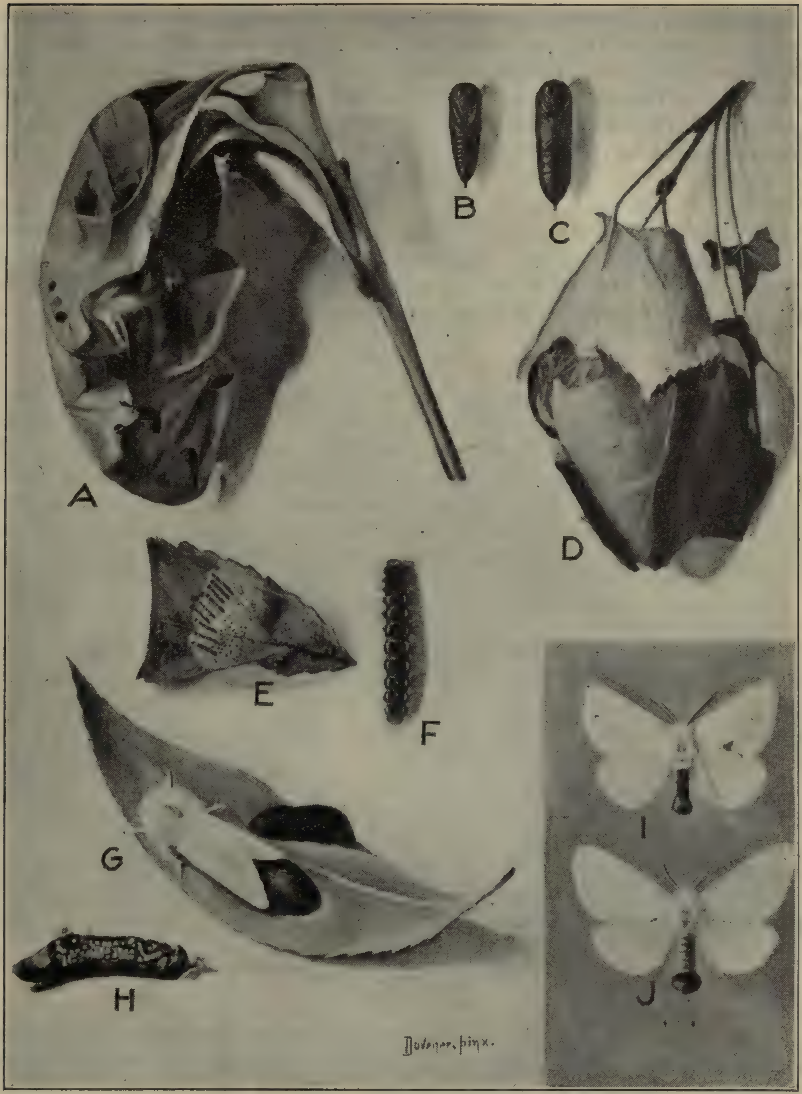

FIGURE 18.—Different stages of the brown-tail moth: A, Winter nest; B, male pupa; C, female pupa; D, cocoon in leaves; E, young caterpillars on leaf; F, full-grown caterpillar; G, female depositing eggs on a leaf, and egg mass also on leaf; H, egg mass removed from leaf and with some of the eggs exposed; I, male moth; J, female moth. All about three-fourths natural size

hair taken from the body of the female. Hatching begins about August 15.

THE LARVAE

The newly hatched larvae or caterpillars feed on the epidermis of the leaf. After molting once or twice they begin to construct a winter web. This is made by drawing together several terminal leaves and securely fastening them by silk which is secreted by the caterpillars. The larvae from one or more egg clusters live and feed in common, and as cold weather approaches they retire to the web, in which they remain during the winter. In the spring these larvae leave the web as soon as the buds begin to develop and feed upon the bud scales and small leaflets. They become full grown about the middle of June.

THE PUPAE

After the caterpillars finish feeding they spin loose silken cocoons and pupate within them. These cocoons are sometimes constructed separately, but in many cases large numbers of them are spun in a single mass. About two weeks are spent in the pupal stage.

THE ADULTS

Emergence of the moth usually begins the first week in July. The adult brown-tail moth is pure white. The abdomen of the female is much larger than that of the male, but in both sexes the tip of the abdomen is covered with dark-brown hairs. These moths are attracted to strong light, such as electric arc lights; and as they fly at night, it is often possible to secure many specimens around the arc lights in cities and towns during the first half of July.

FOOD PLANTS OF THE BROWN-TAIL MOTH

The caterpillars of the brown-tail moth commonly feed on the leaves of apple, pear, cherry, oak, and willow, and they are sometimes found in considerable numbers on other common deciduous trees and shrubs. They never attack conifers and are seldom found on hickory, ash, chestnut, or birch.

Oak foliage is one of the favored foods of the brown-tail moth caterpillars in Europe and was severely injured in New England for a number of years after this insect became established there. It has not suffered in this way in recent years except in 1926 and 1927, when large numbers of webs were found on oak trees and the caterpillars caused considerable defoliation in some localities.

INJURY CAUSED BY THE BROWN-TAIL MOTH

The principal injury caused by the brown-tail moth is due to the feeding of the larvae in the spring. If the infestation is bad the caterpillars are often numerous enough to devour the leaves as fast as the trees are able to develop them. As the webs are made on the terminals, the growth of the trees is often severely checked. In severe infestations trees may be completely stripped (fig. 19), but as the larvae become full grown during the first part of June, there is usually an opportunity for the trees to produce new leaves before midsummer. The young larvae that hatch in August frequently skeletonize the leaves to a considerable extent. This does not damage the trees seriously, as the growing period for the season is nearly completed.

The bodies of the caterpillars of the brown-tail moth are provided with poisonous hairs. A microscopic examination of these hairs shows that the edges are barbed in such a way that when they come in contact with the human skin and are pressed into the flesh, intense irritation is caused. These hairs are hollow and contain a poisonous substance which acts on the blood corpuscles. This causes serious poisoning and severe irritation, accompanied by external swelling, which is known as the brown-tail rash. Persons differ considerably in their susceptibility to this poison, but many cases are reported each year in the infested region, most of which are more serious than those of ivy poisoning. Many camps and summer cottages, particularly in wooded areas, can not be occupied with any comfort during the early summer if the caterpillars are abundant, on account of the poisoning due to these caterpillars. If clothing is hung on the line near badly infested trees the hairs frequently find lodgment and are brought into the houses, and severe poisoning may result later.

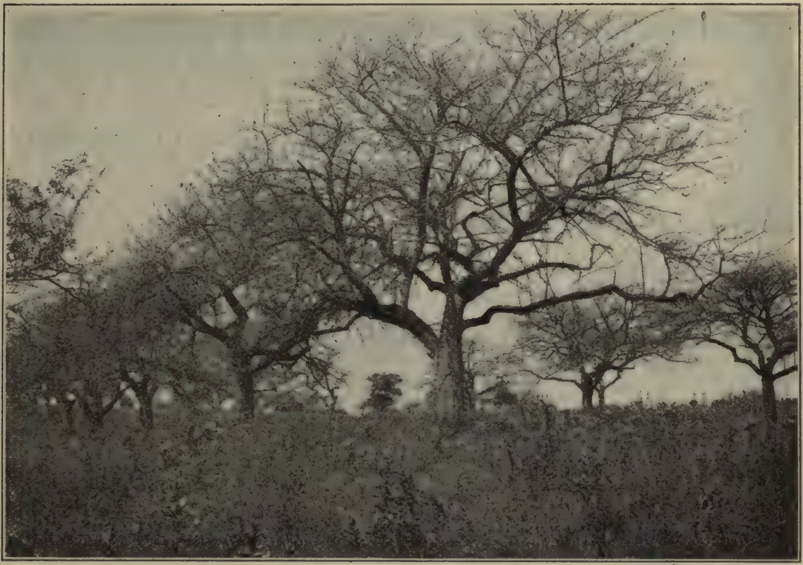

FIGURE 19.—Apple trees defoliated by the brown-tail moth. Note the hibernating webs on the twigs

The brown-tail moth has been less abundant during the last three years than heretofore. There have been local infestations, however, where serious injury resulted, particularly in northeastern Massachusetts, southeastern New Hampshire, and southwestern Maine, and in some of the river valleys in New Hampshire.

NATIVE ENEMIES OF THE BROWN-TAIL MOTH

One of the important native enemies of the brown-tail moth is a fungous disease (*Entomophthora aulicae* Reich.) which attacks the caterpillars, particularly in the spring. It was first reported in this country by Roland Thaxter in 1888. Like all diseases of this nature, the benefit derived from it is regulated largely by favorable or unfavorable weather conditions. This fungus sometimes works to a slight degree on the small caterpillars in the fall, and is found occasionally in the winter webs. As a rule, however, the greatest mortality of caterpillars takes place in the spring, when they are nearly full grown, and the pupae may, under the most favorable conditions, be almost completely exterminated.

Native parasites and predacious insects have done very little to check the increase of the brown-tail moth.

INTRODUCED PARASITES AND ENEMIES

Some of the parasites (*Apanteles lacteicolor* Vier. and *Compsilura concinnata* Meig.) that were introduced as enemies of the gipsy-moth caterpillars also attack those of the brown-tail moth freely, and one additional introduced species (*Meteorus versicolor* Wesm.) is an important enemy of the insect. The Calosoma beetle (*Calosoma sycophanta* L.), both in the adult and larval stages, destroys many brown-tail moth larvae and pupae.

The parasites and natural enemies of this insect are more effective than is the case with the gipsy moth, and extremely low temperature in the winter often proves fatal to a large proportion of the small caterpillars in the webs.

These factors, together with the enormous amount of hand suppression that has been employed in many parts of the infested area, have resulted in a pronounced decrease in the abundance of the insect during the last few years.

METHODS OF CONTROLLING THE BROWN-TAIL MOTH

The brown-tail moth can be controlled by cutting off the winter webs and burning them before the caterpillars begin to emerge in April. These webs should be destroyed by fire, for if they are simply cut from the trees and left on the ground, the caterpillars will emerge, and no benefit will result from the work which has been done.

In orchard practice it is sometimes inadvisable to cut the winter webs, for where an infestation is bad the cutting is likely to leave poorly shaped trees. Spraying in the spring is not a satisfactory remedy unless the infestation is very light, because the caterpillars, when they occur in large numbers, do not allow the tree to put out sufficient foliage to hold the spray material.

The most effective method in orchards is to spray the trees before the midde of August, using 3 pounds of lead-arsenate powder to 100 gallons of water. Before spraying operations of this sort are attempted the orchardist should determine to what extent the trees are infested with egg masses of the brown-tail moth. If the infestation is very slight, it will be more satisfactory to cut and destroy the webs. If the infestation warrants, both shade, ornamental, and fruit trees may be sprayed to advantage at this time. Caution should be used, however, in spraying fruit trees, particularly if early-fall varieties are to be treated. The foliage should be treated, particularly the terminal shoots, and as much care as possible should be exercised not to cover the fruit. Late fall or winter varieties of fruit may be sprayed with lead arsenate in August, and although an occasional spot may be found on the fruit at the time of picking, no injury will result from it. In cases where only a few choice fruit trees are sprayed it is practicable to wipe the fruit before packing for sale;

but this will not be necessary if care is taken to spray only the terminal growth of the trees, as this is where the bulk of the egg clusters are deposited.

The damage caused by the brown-tail moth is ordinarily not so severe as that resulting from gipsy-moth infestation, because the brown-tail moth does not have so wide a range of food plants and, further, because the bulk of the feeding by the larvae is done early in the season, so that the trees have an opportunity to recover before midsummer. In the territory where both insects exist the caterpillars of the gipsy moth supplement the feeding which has been done by those of the brown-tail moth, and the injury is, therefore, greatly increased.

During the last few years this insect has seldom been found feeding on oak foliage, except in the worst infested localities, and elm, maple, and rose are not as badly infested as was the case about 15 years ago.

Thorough destruction of brown-tail moth webs in residential sections and in orchards has resulted in materially decreasing the insect in thickly settled sections. Elimination of worthless apple and wild cherry trees would help greatly in reducing the pest.

ORGANIZATION AND STATUS OF WORK AGAINST THE GIPSY MOTH AND THE BROWN-TAIL MOTH

Each State infested with these insects is carrying on control work, and many of the towns and cities are similarly engaged.

The Dominion of Canada and several of the Provinces have taken up control and eradication work.

MAINE

In Maine the work is in charge of the commissioner of agriculture, who has authority to appoint assistants to take charge of the operations. In the southwestern part of the State the gipsy-moth infestation is general and in places severe, but the greater part of the known infested area is only slightly infested. The severity of infestation increased in 1926 and 1927, and many heavily infested sections were found in 1928. The brown-tail moth is not now seriously abundant except along the seacoast in the southwestern part of the State. Over 12,000 square miles of territory are infested with the gipsy moth and about 7,000 with the brown-tail moth. The former has gradually spread to new territory, but the area infested by the latter has decreased considerably since 1919 and has not changed very greatly for several years.

NEW HAMPSHIRE

The moth work in New Hampshire is in charge of the State entomologist. Over 8,000 square miles are infested with the gipsy moth and about 4,000 with the brown-tail moth. Most of the territory south of Lake Winnepesaukee has suffered severe and repeated defoliation. In 1927 the largest defoliated areas centered around the lake and toward the east and northeast. In 1928 severe defoliation was general throughout the section east of the Merrimac River and to the foothills of the White Mountains. Serious stripping also occurred west of the river in the southern part of the State.

VERMONT

In Vermont the moth work is in charge of the commissioner of agriculture, who appoints an entomologist to carry on the field work. About 6,000 square miles are infested by the gipsy moth, the worst localities being along the Connecticut River. An occasional web of the brown-tail moth has been reported in recent years, but this insect does not appear to maintain itself in numbers in the State.

MASSACHUSETTS

The commissioner of conservation has charge of the moth work in Massachusetts. Each infested town is required by law to select a local superintendent, whose appointment must be approved by the commissioner. Owners are required by law to keep their property free from these pests, but can not be compelled to expend for this purpose more than $5 per year on each $1,000 assessed valuation. Towns and cities must expend funds for proper treatment of the street trees and those in parks and on public grounds. After the amounts fixed by law are expended, financial aid may be supplied by the State. The gipsy moth at present occurs to a greater or less extent in every town in the State east of Berkshire County. It has increased in abundance over much of the infested area during the last three years. The area infested by the brown-tail moth has been reduced so that at present it amounts to only a little over 4,000 square miles.

RHODE ISLAND

In Rhode Island the commissioner of agriculture has charge of the moth work, which is done under the supervision of the State entomologist. The gipsy moth occurs in all towns in the State, and several heavy infestations were treated during 1927 and 1928. The brown-tail moth infestation has decreased rapidly in recent years, and at present none of the towns are known to be infested.

CONNECTICUT

In Connecticut the work is in charge of the State entomologist. The brown-tail moth has not been found in this State for several years. The gipsy-moth area now occupies about 3,000 square miles. Control work has heretofore been effective in controlling the insect, but during the past two years the infestation has been increasing somewhat in the eastern part of the State.

NEW YORK

In New York State the field work against the small number of scattered colonies that had been found up to March, 1923, was supervised by the director of the bureau of plant industry, of the department of farms and markets. At that time the work was transferred to the department of conservation, which has worked cooperatively with the Bureau of Entomology in the New York section of the barrier zone.

NEW JERSEY

In New Jersey the State work is under the control of the State department of agriculture. The funds appropriated have been used in conjunction with Federal funds, and the direct supervision of the work has been in the hands of the United States Bureau of

Entomology. The results, up to the present time, have been very satisfactory.

PENNSYLVANIA AND OHIO

Work on one small colony in Pennsylvania and another in Ohio was done by arrangement with the State officials—in Pennsylvania with the bureau of plant industry of the department of agriculture of that State and in Ohio with the State nursery inspector. The results were satisfactory, as both colonies of the insects have been exterminated.

WORK OF THE DOMINION OF CANADA

Work on the gipsy moth and the brown-tail moth in Canada is conducted by the division of foreign pests suppression of the office of the Government entomologist. Cooperation with the Provincial governments of New Brunswick, Nova Scotia, and Quebec has been maintained. The brown-tail moth is not now known to occur in the Province of New Brunswick but is found in decreasing numbers in the Annapolis Valley in Nova Scotia. The gipsy-moth colony found at Henrysburg, Quebec, has been exterminated through the efforts of the Dominion and Provincial officials, and the insect is not known to occur in Canada at the present time.

WORK OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

The gipsy-moth project has for many years been conducted by the Bureau of Entomology. On July 1, 1928, the quarantine and control work was transferred to the Plant Quarantine and Control Administration, and the research work was assigned to the Division of Forest Insects of the Bureau of Entomology.

The object is to control and prevent the spread of these insects. For a number of years it was believed to be quite impossible to restrict the spread of the brown-tail moth on account of the heavy migration of the adults of this species. In recent years, owing principally to the effectiveness of parasites introduced by the bureau, winter conditions unfavorable to the insect, and in some sections the effectiveness of a fungous disease which attacks the caterpillars, in addition to a large amount of hand suppression work, it has been possible not only to prevent spread but to record a marked reduction in the infested area. In certain sections near the seacoast in New Hampshire and northern Massachusetts and near some of the rivers, however, rather heavy infestations exist. One of the dangers in connection with the brown-tail moth at present is that favorable climatic conditions or temporary scarcity of natural enemies may enable it to increase rapidly and spread proportionately.

The gipsy moth was held in check for several years and did not spread beyond the Connecticut River. During the war period, when extreme difficulty was experienced in maintaining a field force on an effective basis, and funds were inadequate to meet the increased cost of operation, infestations developed rapidly, and strong winds immediately following the hatching period caused an extensive spread of the insect to the west and northwest. Field work indicated that many colonies were established during that period, as scattered infestations were found in the Berkshire Hills section of Massachusetts and Connecticut and in the Green Mountain region in Vermont.

This territory is extremely rugged and very difficult for field operations.

The establishment of the barrier zone has already been discussed in some detail, and the results secured thus far have justified the effort expended.

A large amount of experimental work has been done to devise better methods of controlling these insects. Natural enemies have been introduced from Europe, northern Africa, and Japan and colonized throughout most of the infested area. Specialists have spent considerable time studying the insects in their native homes and collecting parasites for shipment to this country. This phase of the work is being pressed as rapidly as possible. Investigations looking toward the planting and growing of forest trees that are not subject to attack by the gipsy moth are being continued.

The entire area known to be infested by either of these insects is under quarantine, and shipments of nursery stock, lumber, cordwood, and other forest products, including Christmas trees and greenery, and stone and quarry products are not permitted to leave the territory unless they are inspected and accompanied by a certificate stating that they are free from infestation.

COOPERATIVE WORK

Since the gipsy moth and brown-tail moth work was begun by the Bureau of Entomology more or less work has been done in cooperation with the States concerned. The introduction of parasites and natural enemies of the gipsy moth was conducted in cooperation with the State of Massachusetts for several years. After the infestation had covered large areas in other States an arrangement was made for this work to be carried on by the Bureau of Entomology. The general plan of field work in New England is for the States to manage the clean-up east of the barrier zone while the Federal forces work in the zone and cooperate in making the entire work effective.

In New York the barrier zone work is handled in cooperation with the State authorities.

The work in New Jersey is planned with the purpose of exterminating this large infestation, and close cooperation with the State has been maintained.

The gipsy moth and brown-tail moth quarantine covers the entire infested area, and its enforcement has thus far prevented long-distance spread of these pests.

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THE MEXICAN BEAN BEETLE IN THE EAST AND ITS CONTROL

By Neale F. Howard, *Senior Entomologist, Truck-Crop Insect Investigations, Bureau of Entomology*

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THE MOST DESTRUCTIVE INSECT TO GROWING BEANS

THE MEXICAN BEAN BEETLE[1] is the most serious insect enemy of beans in those parts of the United States which it inhabits. It has been long present in the Southwestern States. In 1920 it was discovered at Birmingham and Blocton, Ala. Since that time the pest has spread throughout the greater part of the territory east of the Mississippi River.

APPEARANCE OF INSECT AND NATURE OF DAMAGE

The Mexican bean beetle is a copper-colored, round-backed beetle, with 16 black spots on its back. It is about one-fourth of an inch long and about one-fifth of an inch wide. (Fig. 1, *g*.) The beetle resembles somewhat some of the native beneficial ladybirds.

The larva or immature form is orange colored, varies in length from about one-twentieth of an inch when young to about one-third of an inch when full grown, and is covered with branched spines, which give it a fuzzy appearance.

Injury by the young and adult of the Mexican bean beetle to the bean plant is different from that produced by any other insect which feeds on the beans. The adult, feeding from below, eats ragged areas in the lower surface of the leaf, but often cuts through the upper surface, giving the foliage a lacelike appearance. (Fig. 2.) The larvæ also feed on the under surface of the leaf, but do not cut through the upper surface. The lower tissue is cut away in narrow parallel sections about the length of the insect's body. Between these sections are narrow strips which are left untouched by

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[1] *Epilachna corrupta* Muls.; order Coleoptera, family Coccinellidae.

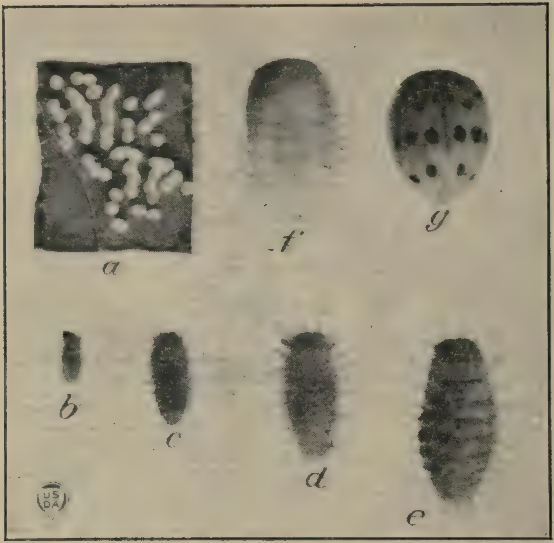

FIGURE 1.—*a*, Eggs of Mexican bean beetle; *b, c, d, e,* first to fourth stages of larva; *f*, pupa; *g*, adult. Enlarged 2½ diameters

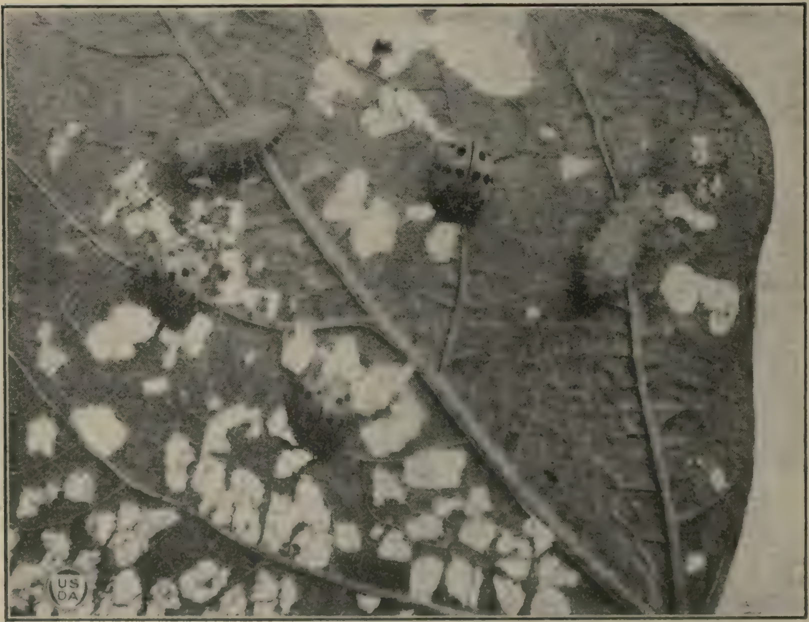

FIGURE 2.—Adults and larvæ of Mexican bean beetle on under side of bean leaf, showing areas eaten by adults. Enlarged 2 diameters

the larva, so that the result is a peculiar network unlike any other insect's injury to beans. (Fig. 3.)

Although the leaves are attacked first, all parts of the plant above the ground may be fed upon by both beetle and larva. When the insects are numerous, an injured plant presents the appearance of being completely dried out. (Fig. 4.) After destroying the leaves, the insect will attack the pods, and even the stems.

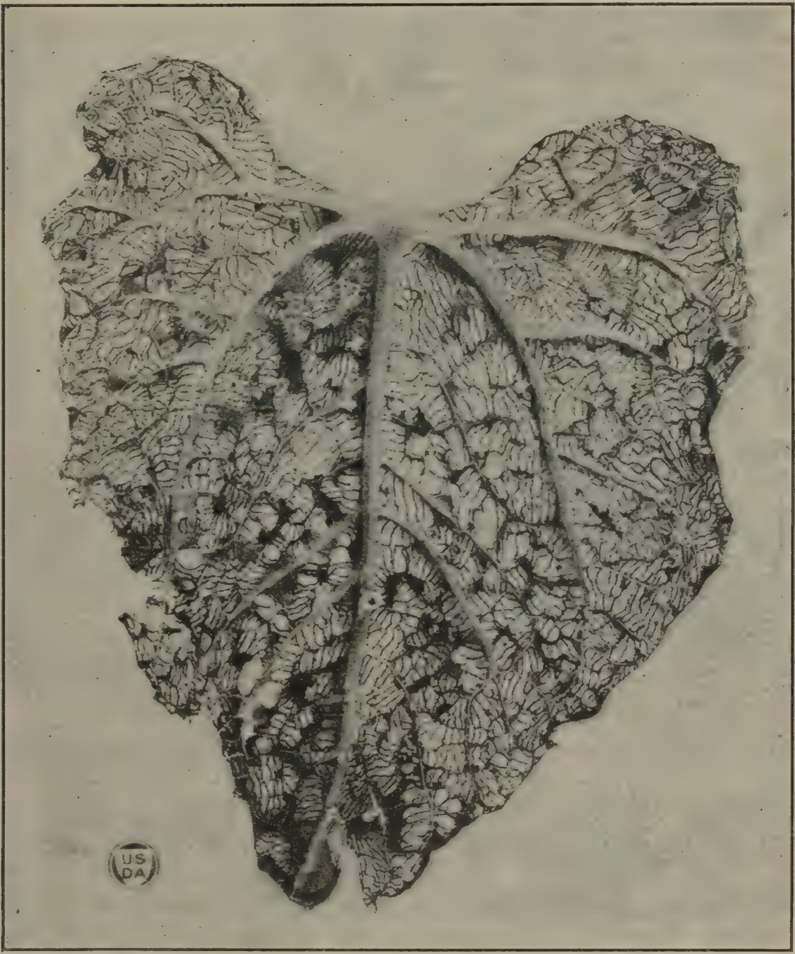

FIGURE 3.—Feeding of larvæ of Mexican bean beetle on bean leaf. Slightly enlarged

When the beetles are abundant, a bean crop may be completely destroyed before the pods are developed.

THE DIFFERENT STAGES

The Mexican bean beetle reproduces by eggs, deposited in clusters of from 40 to 60 on the lower surface of a leaf. (Figure 1 illustrates the different stages of the insect.) The eggs are orange yellow in color. The young or larva when first hatched is about one-twentieth of an inch long, and a few hours after hatching it begins feeding. As it grows the larva molts or sheds its skin. When full grown it is about one-third of an inch long and about one-half as wide. The full-grown larva attaches itself to the under surface of a bean leaf upon which it has been feeding or to some other leaf, weed, or near-by object, and becomes shorter but larger around the body preparatory to pupation.

It then changes to the pupa or inactive stage, which is orange colored, and is attached to the leaf or other object by means of the fourth larval skin. When the beetle develops from the pupal stage it is light-lemon colored and shows no black spots upon the wing covers. The spots soon appear, however, and the beetle gradually becomes darker until after a week or 10 days it has become copper colored. Old beetles and those which have lived through the winter are darker in color and the spots are less distinct.

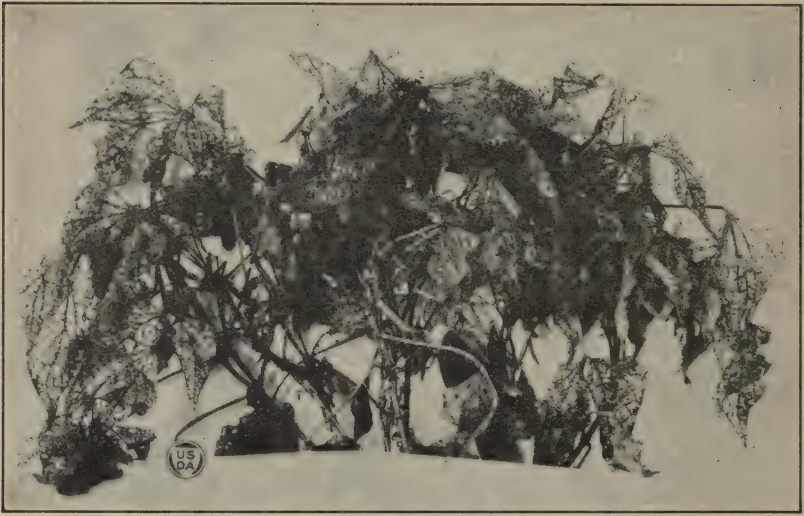

FIGURE 4.—Bean plants in field, destroyed by Mexican bean beetle

REGIONS IN WHICH THIS BEETLE IS FOUND

The Mexican bean beetle probably originally came from Mexico. It has been known in the western part of the United States since about 1850. In this region it is now known to exist in Arizona, New Mexico, Colorado, Wyoming, and Utah, and has also been recorded from western Texas and western Nebraska.

In many districts of Colorado and New Mexico it is recognized as a very serious enemy of beans and one which has periodically caused heavy losses.

Since its discovery in Alabama in 1920 it has spread to all States east of the Mississippi River except Florida, Illinois, Wisconsin, Vermont, New Hampshire, Maine, and Rhode Island. It extends as far north as southern Michigan, southern and western New York, and southwestern Massachusetts, and also to the Province of Ontario, Canada, along the northern shores of Lake Erie and Lake Ontario. (Fig. 5.) It has not proved to be a serious pest over all of this region, however; the worst damage has occurred in the area of the Allegheny Mountains and bordering foothills and valleys from northern Alabama and Georgia to southern Ohio and Pennsylvania.

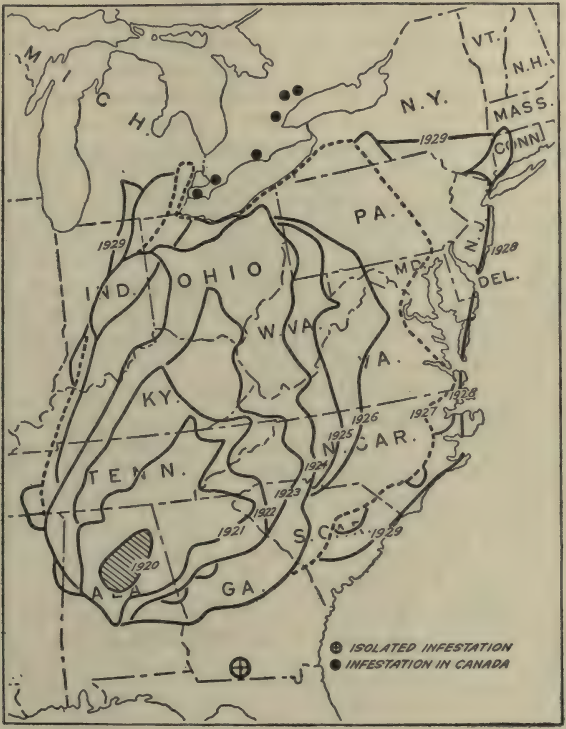

FIGURE 5.—Map showing the known distribution of the Mexican bean beetle in the Eastern States. The heavy lines represent the boundaries of infested territory for each year from 1920 to 1929, inclusive

During 1928 and 1929 it was very injurious in eastern Virginia and Maryland, as well as in the Cape May district of New Jersey.

LIFE HISTORY AND HABITS

The beetles begin to leave their winter quarters in the spring. In the South they first appear in the bean fields in late March or early April, while in southwestern New York they do not appear until June. At intermediate points they appear on different dates, depending on the location. In some places they are present when early beans are still small; in others when the first blossoms appear. After feeding, usually for a week or 10 days, the females deposit their eggs.

Eggs laid in early spring hatch in 10 to 14 days as a rule. As the weather becomes warmer the eggs hatch in less time, in six or even five days. The young that hatch in the early part of the season develop rather slowly and may require five weeks to complete their growth. Later in the season, however, development of the larvæ requires an average of about 20 days. The pupal period during summer weather averages about seven days. Thus the total period of development from egg to beetle averages about 33 days in midsummer.

Within two weeks after emerging from the pupa the female beetle deposits eggs. Some beetles that overwintered may live for three months, but the majority die within one month. The insect reproduces rapidly, and by the time the early crop of beans has matured the beetle has often become abundant. A maximum of three or even four generations of the beetle may occur in the Southern States, but in the North only one generation or one and a partial second are produced. In the Southwest one generation is the rule, but in some sections a second generation occurs.

The capability of the beetle for rapid reproduction under favorable conditions is remarkable. A female may deposit an egg mass every two or three days. As many as 1,669 eggs have been deposited by one female, while the average number observed is 459.

Late in summer and early in fall the first beetles seek winter quarters, and others follow until about the first frost, at which time practically all beetles have left the fields. All stages are present in the field from early spring until frosts in the fall, but eggs and larvæ may become scarce during late summer and early fall.

The spread from the original point of infestation in northern Alabama has been accomplished mainly by flight, with the assistance of prevailing winds. The beetle is sluggish in its movements, but is a comparatively strong flier and may fly many miles. Marked beetles have, within two days, been captured 5 miles from the point where liberated. During 1921 a spread of over 200 miles northward occurred, and in 1922 a spread of over 100 miles, and the average maximum distance covered in the period 1921 to 1924 was 150 miles a year.

HIBERNATION

Only the adult beetle lives through the winter. It hibernates preferably in woodlands near bean fields. It collects in small colonies. As many as 400 beetles have been found in one group covering an area of about 3 square feet, under pine needles and oak leaves on a well-drained, woodland hillside near cultivated bean fields. (Fig. 6.) Some may remain in the bean fields and others about the field or garden under rubbish and plant remains. The beetles have been found in the winter three-fourths of a mile from the nearest bean field, but the majority occur within a quarter of a mile. In the West the beetle may fly many miles to hibernate. In the Southeastern States complete dormancy does not occur throughout the entire winter, since the beetles move about on warm days.

FOOD PLANTS

The Mexican bean beetle is primarily an edible-bean pest, preferring the common bean, such as snap beans (green or string beans), kidney beans, pinto beans, navy beans, and the Lima bean to other kinds. Its second choice of food is beggarweed,[2] or beggartick, which grows wild generally throughout the Eastern States and is cultivated for hay in some sections. The insect can reproduce successfully on cowpeas and soybeans, but injury to these crops is unusual.

NATURAL AGENCIES OF CONTROL

No internal parasite of the Mexican bean beetle had been recorded until 1922, when two native species of flies[3] were found to parasitize the insect in rare instances in northern Alabama. They have never become abundant enough to be of any value.

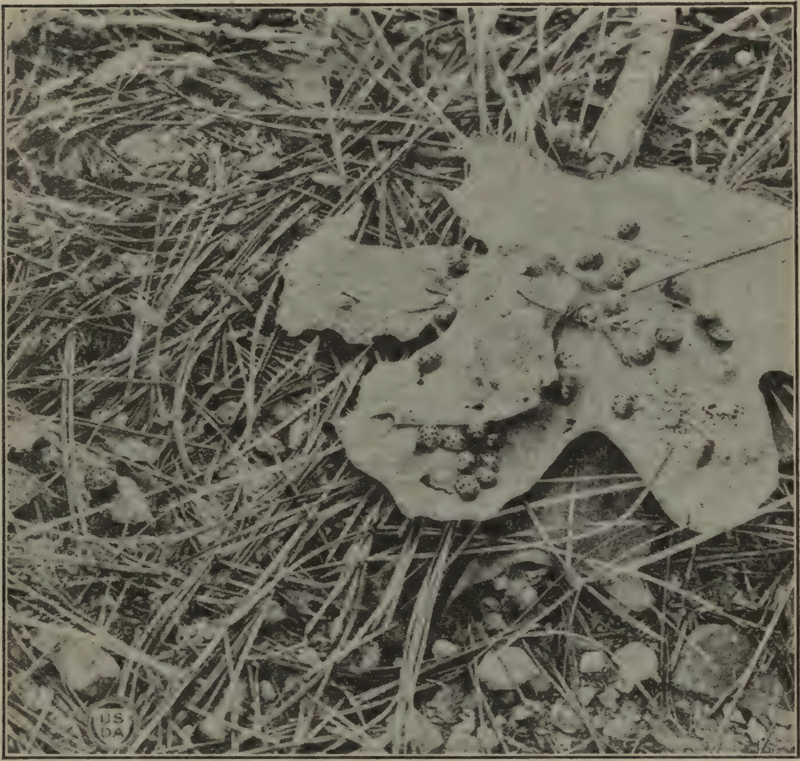

FIGURE 6.—Mexican bean beetle hibernating under pine needles and leaves in woods

A number of predacious insects feed on the eggs and young larvæ, and in some cases on the older larvæ, pupæ, and adults of the Mexican bean beetle. The most common of these in the Southeastern States is the spotted ladybird,[4] which feeds sparingly on the eggs and young larvæ. The "anchor bug"[5] in both immature and adult stages preys on larvæ, pupæ, and adults of this bean beetle. The spined soldier bug[6] attacks all stages. A few other bugs and a few beneficial ladybird beetles feed on different stages of the bean beetle, but are of little importance.

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[2] *Meibomia tortuosa* and *M. canescens*.
[3] *Phorocera claripennis* Macq. and *Helicobia helicis* Towns.
[4] *Megilla maculata* DeG.
[5] *Stiretrus anchorago* Fab.
[6] *Podisus maculiventris* Say.

A tachina fly parasite[7] of this bean beetle is prevalent in some sections of Mexico, and efforts are being made to introduce the species into the United States.

Since the appearance of the Mexican bean beetle in the Southeast, this pest has varied as regards abundance. In general, in the Southeast the numbers of this insect decreased during 1922 and subsequent years until 1928. In 1929 it became extremely abundant over a large part of the Southeastern and Eastern States.

In the West the injury done by this pest to the bean crop has varied from year to year. This has been more or less true in the East, but in many sections the beetle has been sufficiently numerous every year to do serious injury and make the use of control measures necessary. No explanation for this fluctuation can be made other than that weather conditions are probably the most important factors. Heavy rains during the spring and summer seem to be detrimental to the insect. Extreme droughts and hot weather have been observed to act as a material check, especially if the beans suffer from lack of water. Temperature and moisture during the winter are important, and the survival during the winter depends largely on the effects of these factors.

The intense heat in the bright sunlight during hot periods in summer kills many larvæ and pupæ. When dry weather causes the bean leaves to curl, or when varieties of beans which have this habit are grown, many egg masses, larvæ, and pupæ are exposed to the heat and killed.

CONTROL MEASURES

Where the Mexican bean beetle thrives, control measures are essential. The best known remedy for the protection of beans is the application of a spray containing magnesium arsenate. A large number of remedies have been used, but none has given as good results as magnesium arsenate.

MAGNESIUM ARSENATE SPRAY

The recommended spray consists of 2 pounds of magnesium arsenate in 100 gallons of water; or, in smaller quantities, 1 ounce (5 level tablespoonfuls) of magnesium arsenate in 3 gallons of water.

In all experiments tried by the writer 2 pounds of magnesium arsenate to 100 gallons of water has been sufficient, even under conditions of extremely heavy infestation.

To prepare the spray mixture, weigh the proper quantity of magnesium arsenate, then mix it with a small quantity of water, and wash it through a fine strainer into the spray tank in order to prevent clogging of nozzles.

The magnesium arsenate must be applied to the bean foliage where the bean beetle will eat it when feeding, that is, on the undersides of the leaves.

Magnesium arsenate is a stomach poison and therefore not effective until it is taken into the stomach of the insect; hence the insects may not receive a poisonous dose until a day or more after treatment of the crop. It is often difficult to find poisoned insects, since they may crawl into crevices or become shrunken or otherwise succeed in escaping notice.

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[7] *Paradexodes epilachnae* Ald.

WHEN TO APPLY THE SPRAY

Begin spraying when beetles are found in the field. If careful observations are made, spraying may be delayed until the eggs of the beetle become numerous, that is, when an egg group may be found on each 10 feet of row, or when the beetles are present in sufficient numbers to cause noticeable injury to foliage. To find eggs, look on the undersides of the leaves. The majority of the beetles will stop feeding directly after the application of the spray, but they may be found crawling around over the plant for several days thereafter.

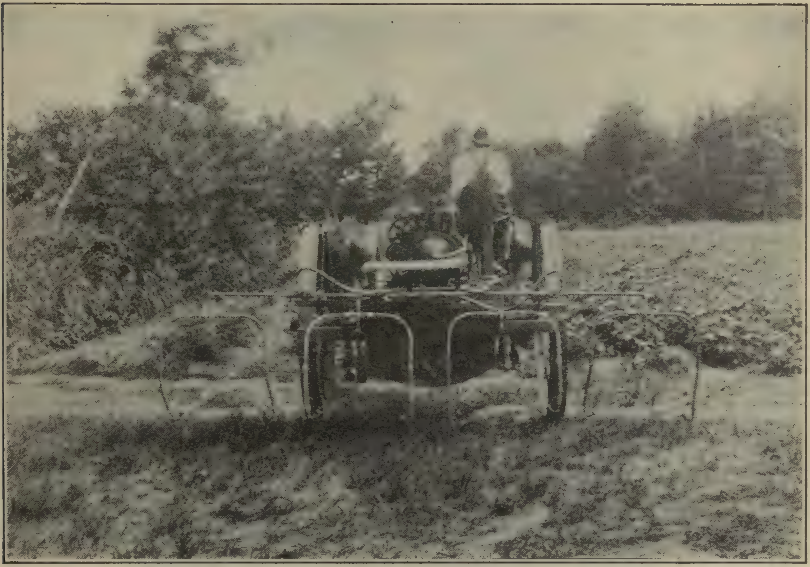

FIGURE 7.—Power sprayer, showing proper arrangement of boom and nozzles for spraying the undersides of the leaves

As the beans grow, the new foliage must be covered with the spray; therefore the treatment should be repeated at weekly or 10-day intervals, especially if the pest is abundant. Very often three or even four sprayings are necessary, but as a rule two thorough applications will be sufficient on snap beans. Growers of Lima beans for market must necessarily protect the crop over a longer period.

SPRAY MACHINES

The grower of 4 or 5 acres of beans, or more, should use a horse-drawn power or traction spray machine, which will spray 3 to 8 rows at a time. (Fig. 7.) There is no entirely satisfactory sprayer available for small plantings of 1 or 2 acres which are too large to be sprayed economically with a compressed-air or knapsack hand sprayer. (Fig. 8.)

Some growers have, however, used a barrel sprayer on a wagon bed or a 2-wheeled cart for small plantings, arranging a boom and two nozzles to direct the spray to the under surfaces of the leaves. Such an arrangement requires the services of two men and hence is not very economical.

It is important that the spray be directed to the undersides of the leaves. To spray the upper surfaces only is almost useless. To reach the under surfaces of the leaves, the spray nozzles should be attached to the discharge pipe by a 90° elbow and a 45° elbow, as shown in Figure 9. When a power or traction machine is used it is well to have a third nozzle placed above the row. (Fig. 7.)

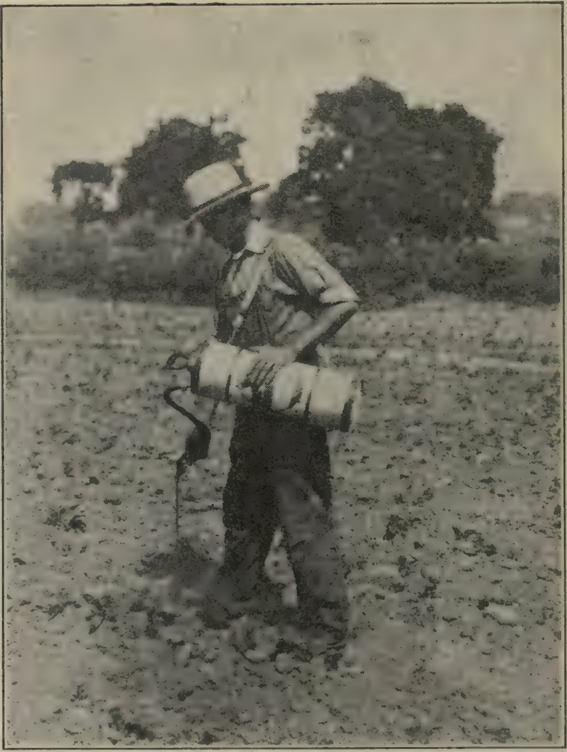

FIGURE 8.—Compressed-air sprayer with hose and extension to reach the undersides of the leaves

The liquid must be agitated continuously so as to keep the magnesium arsenate from settling in the tank or sprayer.

A pressure of 150 pounds or more is necessary so as to blow the leaves about and insure thorough coverage. Pressure higher than 250 pounds is unnecessary.

New disks should be placed in the nozzles after a total of 10 to 15 hours of spraying. The holes in the disks become enlarged with use, and unless disks are replaced an unnecessary quantity of spray material is used.

The boom should be the proper width to suit the width of the rows, and all fields should be planted similarly so that no adjustment of nozzles will be necessary in spraying different fields.

In the case of young beans the boom should be lowered until the nozzles are about 2 inches above the ground. As the plants grow, the boom may be raised accordingly.

On uneven land it is well to have sections of rubber hose in the vertical outlet pipes, so as to make them flexible and thus prevent breaking of the pipes when passing over rough ground. (Figs. 7 and 9.)

Under certain conditions, when a light or "spotted" infestation occurs on a large planting, it may not be necessary to spray the whole field. In such instances the isolated patches which show beetle or larval injury may be sprayed economically by one man with a 3 or 4 gallon compressed-air sprayer. In this manner the infestation may be so reduced as to save later crops from injury. Some growers have practiced this method with success. The nozzle should be arranged so as to spray the undersides of the leaves. (Fig. 9, A.)

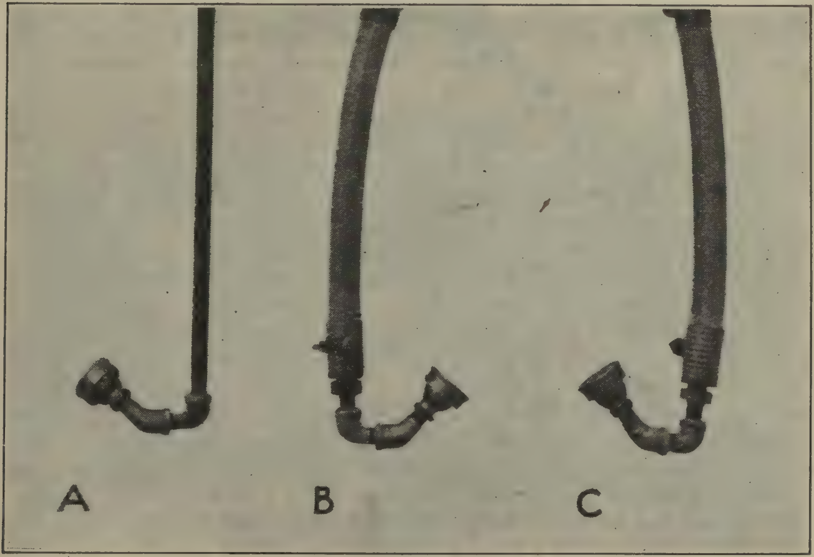

FIGURE 9.—Arrangement of nozzles necessary to spray the undersides of the leaves: A, For hand sprayers; B, C, for power or traction sprayers, with hose sections to prevent breaking pipes

WARNING

Magnesium arsenate is poisonous to human beings and farm animals as well as to insects, and care should be exercised in handling the material to avoid accidents. Since it is primarily a stomach poison, the hands should be washed after handling the material so as to prevent any possibility of getting it into the stomach with food. Any cuts or broken skin on the hands and arms of the operator should be well bandaged to prevent the possibility of irritation from cantamination by the arsenical.

It is not recommended that arsenical sprays be applied to snap beans after pods have set. Under usual conditions, careful applications up to the time of full blooming will give sufficient protection.

SUBSTITUTE CONTROL MEASURES

Dusting with arsenical dust mixtures may be practiced, but the results obtained are not as satisfactory as those from spraying. Magnesium arsenate is not entirely satisfactory as a dust, but may be used with 3 parts of hydrated lime and applied at the rate of 15 to 20 pounds per acre. Calcium arsenate may also be used, but many brands are too injurious to bean foliage to be recommended. A number of brands may be used when mixed with 7 parts of hydrated lime or when mixed in the proportion of 15 pounds of the calcium arsenate with 15 pounds of monohydrated copper sulphate and 70 pounds of hydrated lime. Many growers have used a mixture of 20 pounds of calcium arsenate, 20 pounds of monohydrated copper sulphate, and 60 pounds of lime with good results. However, the grower can not be certain that foliage injury may not result from the use of mixtures containing calcium arsenate.

In experiments at Norfolk, Va., reduction in yields resulted from the use of many calcium-arsenate dust mixtures, probably due to the grades of calcium arsenate used. Present knowledge does not permit the specification of a calcium arsenate which can be used on bean foliage without injury. It is known that high humidity, or dusting of plants wet with dew, increases plant injury from calcium arsenate.

Calcium arsenate may be used as a spray with Bordeaux mixture without appreciable plant injury. A Bordeaux mixture prepared with either 3 pounds of copper sulphate, 4½ pounds of hydrated lime, and 50 gallons of water, or 4 pounds of copper sulphate, 6 pounds of hydrated lime, and 50 gallons of water, may be used with 1 pound of calcium arsenate to 50 gallons of the mixture. In addition to the beneficial effect in reducing injury from calcium arsenate, Bordeaux mixture is useful in controlling the bean leaf hopper.[8] While Bordeaux mixture may visibly injure bean foliage, the plants quickly recover, and as a rule normal or increased yields result from its use.

Magnesium arsenate may also be used successfully with Bordeaux mixture.

Lead arsenate should never be used on bean foliage. Serious injury and reductions in yield often result from its use, even with Bordeaux mixture.

Pyrethrum sprays, which are extracts of pyrethrum flowers, may be used successfully, but the high cost of the material makes their use expensive on commercial acreages. When it is necessary to treat snap beans after the pods are present, these extracts are recommended on account of their nonpoisonous qualities. Pyrethrum extract is primarily a contact insecticide and must touch the insect in order to kill it.

PLOWING

As important as thorough spraying is the destruction of the crop remains after picking, especially in the case of snap beans. The fields should be plowed at least 6 inches deep, special effort being made to cover all the bean foliage. Under usual conditions a high percentage of all stages of the insect may be killed when thorough plowing is done.

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[8] *Empoasca fabae* Harr.

There is reason to believe that the Mexican bean beetle could be so reduced in numbers by proper destruction of infested bean crops after harvest, over an area the size of an average county, that less spraying would be required. Benefits derived depend largely on the thoroughness of the disposition of crop remnants.

COMMUNITY COOPERATION

One of the important sources of infestation is the small garden in towns and settlements. A few untreated rows of beans in a neglected garden are often the breeding ground of many hundreds of beetles, which may spread to commercial acreages in the vicinity. In one locality in Virginia all garden beans in the neighborhood of large plantings are treated cooperatively. Many canners supply insecticides and hand sprayers to small growers at cost and give advice as to their use, and thus contribute to the control of the beetle to the benefit of the whole community. Similar assistance is given in many sections by the farm bureaus in cooperation with the county agricultural agent.

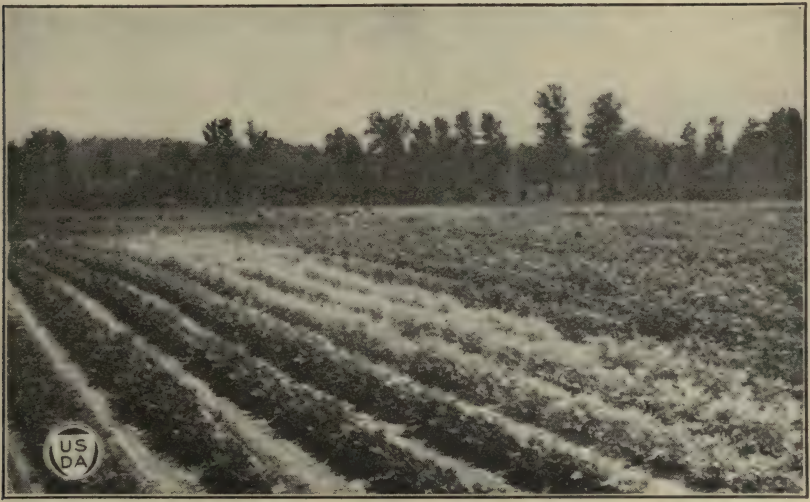

FIGURE 10.—Untreated beans destroyed by Mexican bean beetle beside beans sprayed with magnesium arsenate

CULTURAL PRACTICES

The date of planting snap beans to escape injury from the Mexican bean beetle is important in some sections, especially in instances where it is not necessary to have the crop mature at any certain time. No general rule can be made for all the Eastern States. In some sections beans planted very early escape serious injury. In other sections beans planted at the time when the overwintered adults are disappearing escape serious injury. This is the case in southern Ohio, where beans planted the third week in June may mature without heavy damage, because the overwintered beetles have almost disappeared by the time the beans are out of the ground, and the beans are blossoming by the time the first brood of new adult beetles are numerous.

SUMMARY OF CONTROL MEASURES

The best control for the beetle is magnesium arsenate used at the rate of 2 pounds to 100 gallons of water or 1 ounce to 3 gallons. Proper treatment when beetles are numerous results in an excellent crop of beans, whereas untreated fields are often completely destroyed. (Fig. 10.)

The liquid must reach the undersides of the leaves, and the spraying must be done thoroughly.

Begin spraying when the adults are found in the field or the eggs of the beetle become numerous on the undersides of the leaves.

One to three, sometimes four, applications are required, depending on the abundance of the insect.

Stop spraying snap beans when pods have begun to form.

As important as thorough spraying is the destruction of the crop remains after harvest. Plow under all plant remnants at least 6 inches deep.

Dusting may be practiced but does not give as good results as spraying; and when calcium-arsenate mixtures are used plant injury often results.

Arsenicals are poisonous. Handle them carefully and avoid accidents.

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TICK FEVER

By JOHN R. MOHLER, *Chief of the Bureau of Animal Industry*

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INTRODUCTION

TICK FEVER, a very serious obstacle to the cattle industry of the South, has been fairly thoroughly understood since the investigations made by Smith and Kilborne, of the Bureau of Animal Industry. Their work showed conclusively that the cause of the disease was a minute parasite living within the blood cells, the intermediate stage of the development of which occurred in the cattle tick, *Boophilus annulatus*,[1] thus making this tick the indirect but absolutely essential factor in the natural production of the disease. Above the latitude where the cattle tick is destroyed by the cold of winter the disease can be controlled by keeping southern tick-infested cattle from passing through the country during certain seasons. It is also known that by severing the relations of the fever tick and native cattle the former may be exterminated, thus making it possible to eradicate the disease, and thereby to remove a constant menace to the southern cattle breeder, feeder, and dairyman. Especial pains will be taken to make as clear as possible the absolutely proved facts regarding the disease, so that every cattle owner will be able to recognize the malady and to carry out successfully measures for eliminating the tick which causes it.

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[1] The American cattle-fever tick has been given various names, including *Ixodes annulatus* Say, 1921; *I. bovis* Riley, 1869; *Boophilus annulatus* Stiles and Hassall, 1901; and *Margaropus annulatus* Hunter, 1908. The preferred name is the one used here, *Boophilus annulatus*.

NAME AND SYNONYMS

Of the long list of terms applied to this disease, none seem to fill completely all the requirements of an ideal name. "Texas fever," although the term most commonly in use in this country, is a very misleading one, as it gives to the uninformed the impression that the disease is confined to the State of Texas. Southern cattle fever is especially inapplicable, as the disease is usually more virulent in northern cattle when once infection becomes manifest than in southern cattle. Probably the best name to apply to the disease, since it can be transmitted only in a natural way by the tick, *Boophilus annulatus*, is that of tick fever. Other synonyms besides those already mentioned are red water, black water, distemper, acclimation fever, murrain, dry murrain, yellow murrain, bloody murrain, Mexican fever, Spanish fever, splenic (or splenetic) fever, protozoan cattle fever, hemaglobinuria, tristeza, paludism of cattle, bovine periodic fever, bovine piroplasmosis, and bovine malaria.

DEFINITION

Tick fever is a specific, infectious disease of the blood of cattle, caused by the development and activity of minute animal parasites (Protozoa) which are conveyed to the affected animals by means of the cattle tick, *Boophilus annulatus*. After the microscopic protozoan is injected into the blood of a susceptible animal it attacks the red blood cells, causing them to break down. The disease is characterized by high fever, by destruction of red corpuscles, and the consequent excretion of the coloring matter of the blood by the kidneys, causing a reddish discoloration of the urine, by enlarged spleen, engorged liver, thick, flaky bile, more or less jaundice, emaciation, and death in from 10 per cent of the chronic to 90 per cent of the acute cases. The peculiarity about this disease is that the animals responsible for the spread of the malady are apparently healthy, although containing the Protozoa in their blood, while those that become diseased do not, as a rule, convey the affection to others. In the few instances where they do, it is not by contact, but indirectly by means of the progeny of the ticks from these diseased animals. Infection is not transmitted by the air, urine, saliva, manure, or in any other natural manner than by cattle ticks.

HISTORY

Tick fever was probably introduced into the United States with the importations of cattle by the Spaniards during the early colonization of Mexico and southern United States.

The disease caused continual losses year after year during the early history of this country. It seems to have been described first by J. Pease toward the close of the eighteenth century. At that time a very severe outbreak of the disease occurred in Lancaster County, Pa., and Pease, after investigating the conditions, claimed it to have been due directly to the shipment of some North Carolina cattle into the State. Experience soon showed that the invariable result following the transportation of southern cattle into the Northern States was the death of all northern cattle along the roads and on the pastures over which the southern cattle had traveled, although the latter animals remained perfectly healthy. In the same way northern cattle taken south almost invariably succumbed to the malady.

These losses prompted the study of the disease by many scientific men, whose investigations soon established the great danger of allowing southern cattle to pass into the Northern States during hot weather, and finally resulted in 1885 in the location of the infected district and the establishment by D. E. Salmon in 1891 of the southern cattle quarantine line.

Smith, of the Bureau of Animal Industry, was the first (1889) to recognize and describe as Protozoa the intracellular parasites which are the direct causative agents of the disease. In 1889 and 1890 Kilborne, of the same bureau, by conclusive field experiments suggested by Salmon, proved the presence of the cattle tick to be essential in the transmission of the disease. This was the first experimental proof furnished on the subject of diseases borne by insects, or diseases that can be carried from one animal to another only by an intermediary host. This mode of transmitting infections has since become familiar to the public by the discovery that certain species of mosquitoes spread malaria and yellow fever to man.

It was suggested by the experiments of the Bureau of Animal Industry in 1892 and 1893 that, through the production of a mild, nonfatal attack of tick fever in northern cattle, a very considerable degree of protection is afforded against the disease when these cattle are subsequently exposed to the infection on tick-infested pastures.

From 1895 to 1897 additional experiments were conducted by the bureau with the object of further demonstrating the possibility of immunizing cattle against tick fever by the use of blood obtained from southern cattle; and experiments with a similar object in view were likewise instigated and perfected about this time at the experiment stations of Missouri, Texas, Mississippi, Louisiana, and by the Australian Government, with most excellent results. Later experiments with the disease have been performed principally with the view of obtaining a satisfactory chemical solution in which to dip tick-infested cattle for the purpose of destroying these parasites, and of developing some methods that may be easily carried out for freeing fields, farms, and counties of the cattle tick.

The results obtained in these experiments were so promising that it was believed to be feasible to undertake the complete eradication of the fever tick from the United States, and on July 1, 1906, Congress made available an appropriation of $82,500 with which to begin this work. Since that time this project has continued without interruption and gratifying headway has been made in completely freeing large areas of the country from this parasite.

CAUSE OF THE DISEASE

The primary or direct cause of tick fever is the microparasite *Piroplasma bigeminum*, belonging to the lowest form of animal life, the Protozoa. This minute parasite is found in the blood (fig. 2,[2] No. 5) in every case of tick fever; and by inoculating blood containing it into susceptible cattle, the disease can be invariably transmitted, thus proving its direct causative effect in the production of the malady. After entering into the circulation the Protozoa undergo several stages of development which will not be dwelt on here. The parasites may occupy nearly one-fourth of the body of the red blood cells and, as can be readily understood, exert a detrimental influence upon them. The periphery of these blood cells becomes shriveled or crumpled, and they finally break up, liberating the Piroplasma, which may be observed as free bodies in the circulation—most frequently in the kidneys. The stage of reproduction or multiplication of these Protozoa has never been observed in this laboratory, but that it does occur is proved by the fact that inoculation of a small quantity of virulent blood into susceptible animals will give rise to the disease with myriads of parasites in the blood. The natural path of entrance of these Protozoa, however, is by one channel only, namely, through the bite of the cattle tick. Therefore a knowledge of the habits and life history of the latter is extremely important in controlling the disease, because without this tick the fever would be unknown.

LIFE HISTORY OF THE CATTLE TICK AND THE PART PLAYED BY IT IN PRODUCING TICK FEVER

In stating the interesting and important life history of this tick, it is well to start at the point where the fully developed and fertilized female, being engorged with blood and ready to lay her eggs, loosens her hold on the bovine animal and drops to the ground. On reaching the ground she may lie quietly for several days before depositing her eggs. Egg laying may consume from 4 to 8 days in summer and 2 weeks or even longer in the fall. The number of eggs laid by a fully developed female varies from 1,500 to 3,000, while the immature females also lay eggs, but in much smaller numbers. After laying is finished the female is small and shriveled up and, having fulfilled her mission, soon dies. (Fig. 2, No. 3.) The eggs, which are light brown and waxy in appearance, proceed to develop the larvæ, or seed ticks, the time required for which varies from 13 days to 6 weeks, depending on the conditions of temperature, moisture, soil, etc. These eggs, however, are very tenacious of life, and under unfavorable conditions may remain dormant for several months—from late fall to early spring.

The larvæ, or seed ticks, are minute, 6-legged parasites of a brownish, waxy color, and about one thirty-second of an inch in size. (Fig. 2, No. 2.) They crawl actively about on the ground and among leaves, bunching in large numbers on grass blades, shrubs, weeds, and fence posts, to await an opportunity for attachment to their passing host. The parasitism is so perfect that in case no cattle or horses are present no further development occurs, and death finally results. It is known, however, that these larval forms can live for 3 or 4 months on the ground in warm weather independent of their

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[2] 1, Larva of cattle tick (× 25); 2, same (natural size); 3, mature female and eggs; 4, hide showing cattle ticks; 5, blood cells containing tick-fever Protozoa (× 1,000); 6, male cattle tick (× 15); 7, same (natural size); 8, young female cattle tick (× 15); 9, same (natural size); 10, verious stages of cattle ticks.

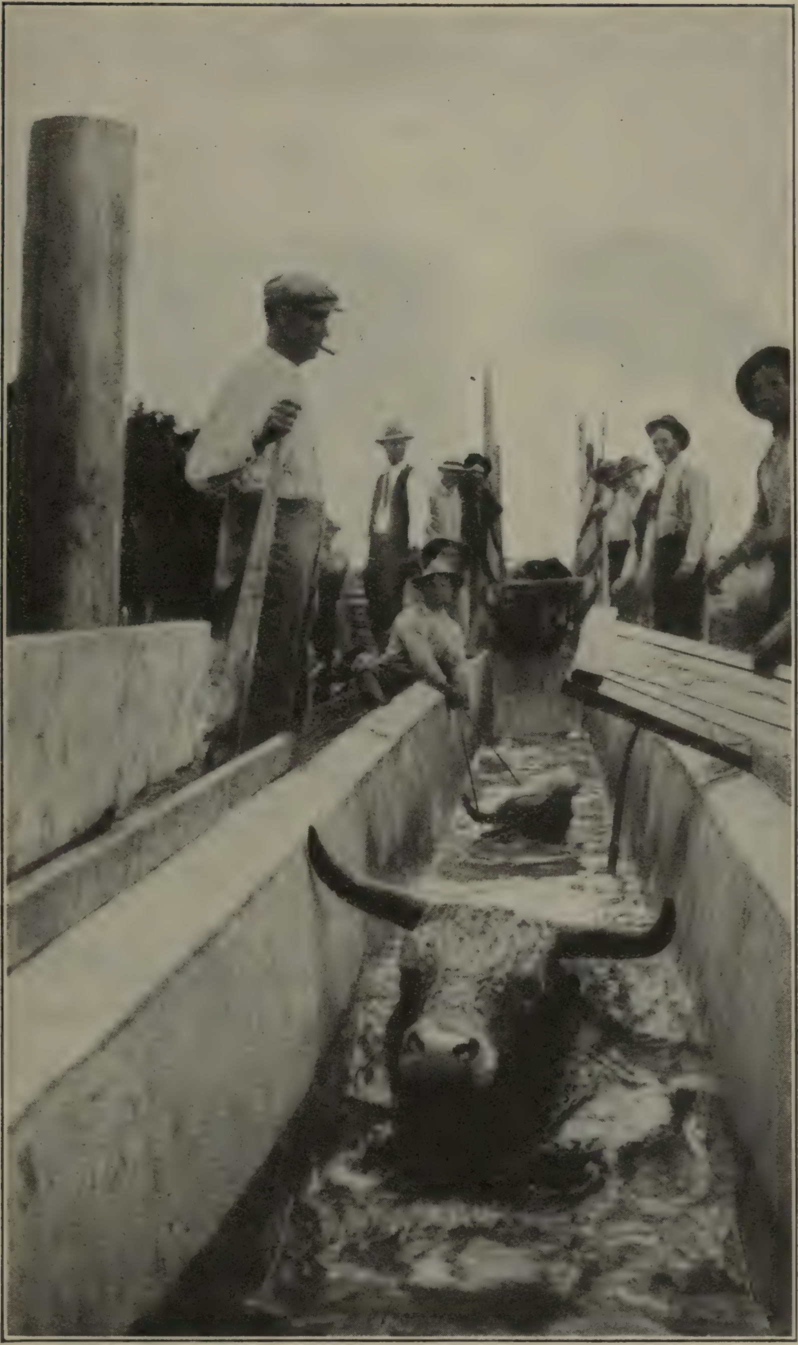

Figure 1.—Dipping cattle to eradicate ticks. The dipping vat contains a weak arsenical solution, harmless to cattle but fatal to ticks

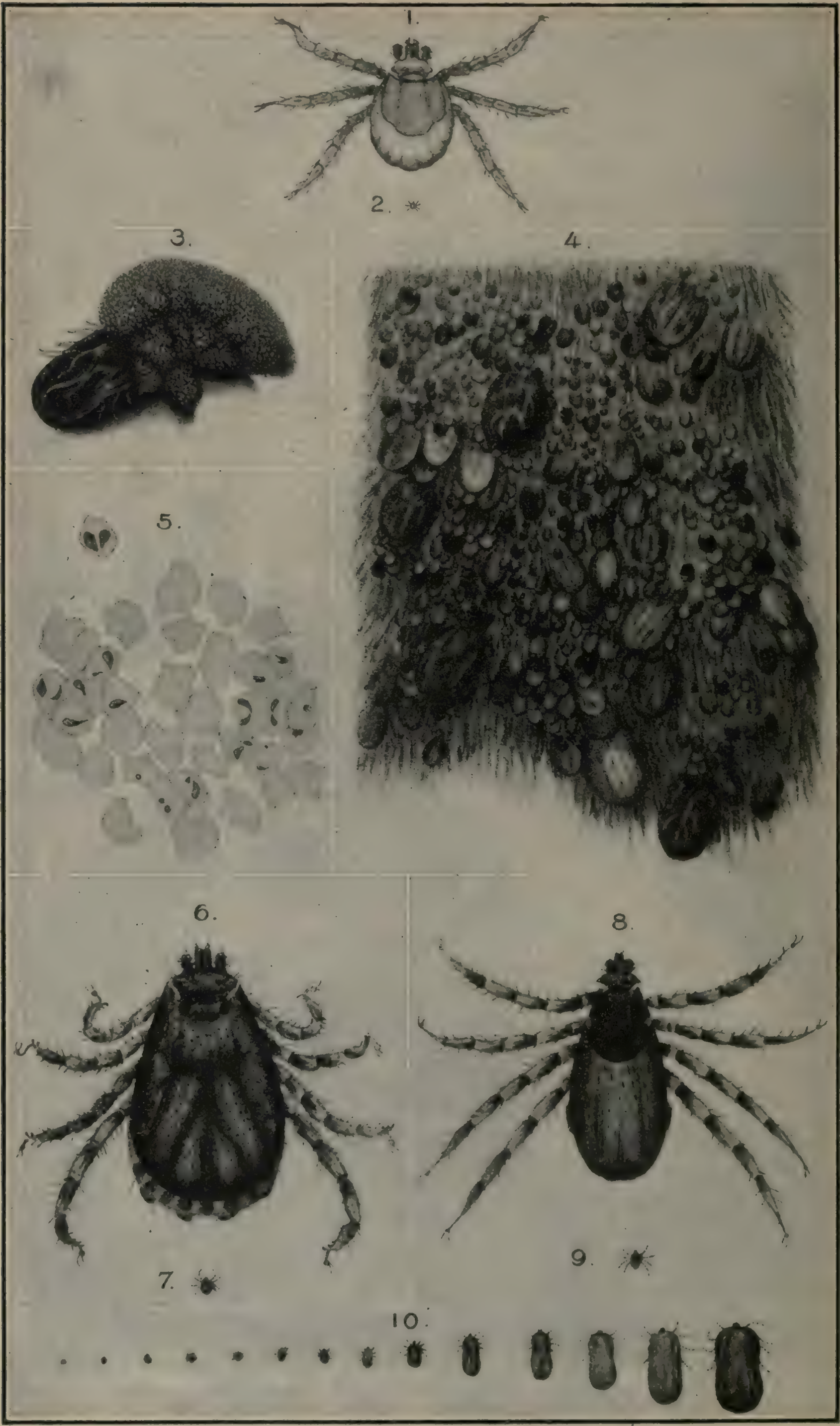

FIGURE 2.—Tick-fever Protozoa and the ticks which transmit them

host, and from late September until April during an open winter. When they find cattle, however, they fasten themselves to the soft skin inside the thighs and flanks, on the escutcheon, along the belly and brisket, around the root of the tail, and inside the forelegs. (Fig. 2, No. 4.) They obtain their nourishment by drawing blood from the host, and can convey the fever at this stage, although so small as scarcely to be detected by the naked eye. After being on the animal about one week the seed tick casts its covering (molts) and appears as the 8-legged, nymph stage of the parasite, having added one pair of legs posteriorly. During the nymphal stage the sexual organs develop, and at the second molting, from the nymphal to the adult stage, the sexual organs are complete. The male and female at this stage are about the same size, as the female does not become very large until after she becomes fertilized, which occurs about 2 weeks after the 6-legged seed tick reaches its host, or shortly after the second molting. (Fig. 2, Nos. 7 and 9.) After mating, the female slowly enlarges for 6 to 20 days in summer, and then rapidly increases in size in the course of a day or two before dropping from the animal. In fall and winter, development occurs more slowly, the tick not falling off for 6 weeks or more. After reaching the ground the female soon commences to deposit eggs, thus completing the life cycle, which requires from 6 to 10 weeks in warm weather, or a much longer period during the cold season.

It will thus be seen that these females transmit the infection through their eggs to their progeny, and the latter have the power to infect any susceptible animal to which they attach. The disease, therefore, is not conveyed by the same ticks which take up the infected blood, but only through the generation descending from them.

Although young ticks are very active, neither they nor the adult ticks are capable of crawling very far, but they may be transported long distances by animals, by rains, by winds, cattle cars, hides, and on the clothing of man. Hence the constant danger that tick-free pastures below the quarantine line may become infested with ticks at any time.

HOW TO DISTINGUISH HARMLESS TICKS FOUND ON CATTLE FROM CATTLE-FEVER TICKS

The fever tick is continually confused with a number of other ticks occasionally found on cattle, which, so far as concerns the transmission of tick fever, are entirely harmless to them. It is this lack of identification and the inability of many cattle owners to distinguish between these various ticks that have caused so many diverse opinions regarding the important part played by the cattle tick in transmitting tick fever. In order to differentiate between the ticks that may be found on cattle, a brief description of the upper surface of the maturing or adult female of each is here given, together with illustrations of this view of the ticks, natural size, and also magnified four diameters. It is not thought necessary to describe the male and immature female ticks at this time, inasmuch as these ticks are much smaller in size, and therefore it is more difficult to recognize them by means of the naked eye. Moreover, it is usually possible to secure a maturing female in those instances where a diagnosis is desired, and at this stage of development ticks possess certain characteristics features or markings which should cause them to be classified readily as harmful or harmless even by superficial examination.

There are eight species of ticks which have been found on cattle in this country, but the first six mentioned are by far the most common. They all show the same successive stages of development, namely, eggs, larvæ or seed ticks, nymphs, and adult male and female ticks. Those parts of the adult female tick which will be described below are the head and adjacent shield—which together have erroneously been termed the head parts—and the back of the body, since these portions of the parasite furnish features which to the naked eye are the most readily distinguished by cattle owners. Much stress can not be laid upon the color of these various ticks, as it changes considerably with age.

CATTLE TICK

Figure 3, 1a, shows the natural size of an adult female cattle tick (*Boophilus annulatus*), whose characteristic markings are better brought out in No. 1, magnified four times.[3] This tick may be readily distinguished from the other seven ticks by the small size and the color of the head and shield, the so-called head parts, whose lateral borders are straighter and more nearly parallel, as shown in No. 1b. These head parts are short and relatively broad and dark reddish brown or chestnut brown in color. The body is oblong oval in shape and may reach one-half inch in length. The color varies from a dull yellow to an olive brown; often it is mottled with irregular areas of yellow and brown or streaked with wavy lines of these colors. Two grooves or indentations are seen running from the front to the rear on the skin of the back, which become almost, if not entirely, effaced at about the middle of the body. Another groove is seen between these two grooves in the posterior half of the body. These grooves are caused by the contraction of the muscles of the body and therefore vary considerably, entirely disappearing when the tick is full of blood. They are very distinct when the ticks have been removed from cattle several days. The four pairs of legs are brown, moderately long, and very slender. This tick is found principally on cattle, less frequently on horses, mules, and asses, and occasionally it is found on deer.

CASTOR-BEAN TICK

The body of the castor-bean tick (*Ixodes ricinus*) (fig. 3, Nos. 2 and 2a) resembles in shape that of an eggplant, and it takes its name from its similarity to the bean of the castor-oil plant. It is lead colored, with a variegated mixture of yellowish red, brown, or gray. The body contains two anterior grooves that slightly diverge from each other, and three posterior grooves, the middle one of which is straight, while the other two are curved outward. The mature female is from three-eighths to seven-sixteenths inch long and has four pairs of dark-brown, thin legs. The head and adjacent shield are a shiny, dark brown or a chestnut brown, the latter portion being 5-sided, like a pentagon (No. 2b), with lateral borders prominent and rear angle

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[3] In Figures 3 and 4 various ticks that infest cattle are shown as follows: The natural-sized mature female tick, this tick magnified 4 times, and the head and shield of the same enlarged 10 to 15 times.

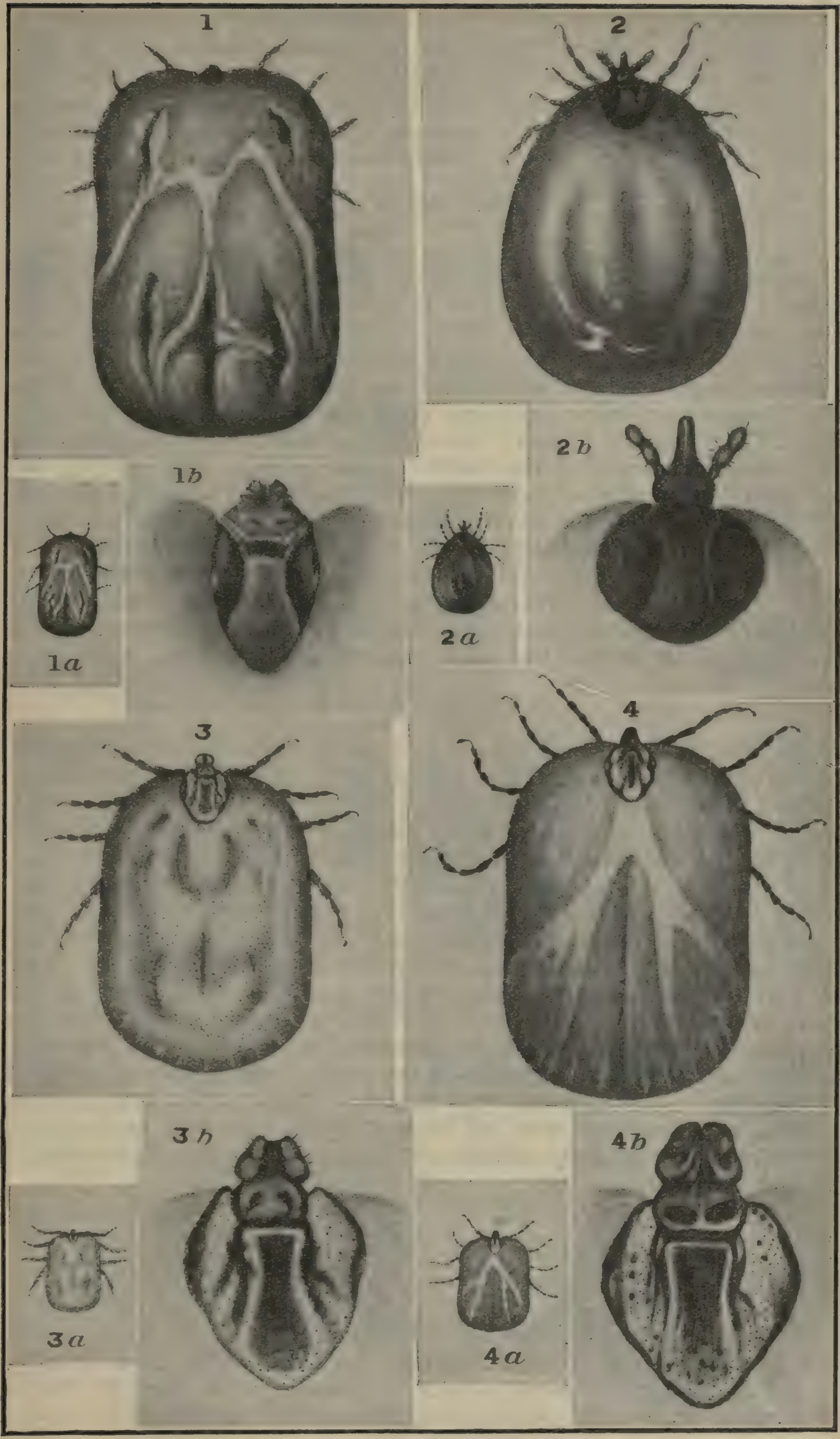

FIGURE 3.—Various ticks that infest cattle

rounded. Two stout and well-developed feelers (palpi) may be seen extending outward on each side of the head. This tick has been collected from sheep, cattle, goats, horses, deer, dogs, cats, foxes, rabbits, birds, man, and a few other animals. It was one of the first ticks studied, and has a very wide distribution in the United States.

WINTER TICK

The body of the adult female winter tick (*Dermacentor albipictus*) is oblong oval, five-eighths inch long, and of a deep-brown or slate color. (Fig. 3, Nos. 3 and 3a.) It has four pairs of brown legs of moderate length. The skin of the back and head is covered with fine points, or punctations, which almost disappear at this stage. Besides the grooves that are located like those in the cattle tick, there is a marginal groove extending around the body just inside the border. There are also 11 small indentations (festoons) arranged about the posterior margin of the body. These festoons and grooves become shallow or effaced in the engorged female. The shield portion of the head parts has a silvery white metallic rust extending along the two sides and posterior portion. (Fig. 3, No. 3b.) It may have a rose or greenish tinge. The head is larger than that of the cattle tick. The winter tick has been found on man, cattle, horse, sheep, and deer; and in this country it seems to be the most common in the West, especially in California, Texas, and New Mexico.

AMERICAN DOG TICK

The American dog tick, also called wood tick (*Dermacentor variabilis*) (fig. 3, Nos. 4 and 4a), resembles the winter tick (*D. albipictus*) so closely that a hand lens must be used to distinguish between them. However, it can be readily known from the cattle tick by the fact that the so-called head parts are longer and broader. (No. 4b.) Here there is also a yellowish-white rust in the posterior portion which extends anteriorly along each as two bright, iridescent lines separated by a central brownish area. The body is oblong oval in shape and measures as much as three-fifths inch in length. The skin of the back contains grooves like those found in cattle ticks, and, in addition, another grove extending around just inside the margin, together with 11 smaller grooves (festoons) of the posterior border. These lines, so distinct in the young female, become shallow at maturity. This tick has been found on man, cattle, dogs, horses, rabbits, and panthers, and has been collected in woods and on uncultivated lands in many sections of this country, especially in eastern United States.

LONE STAR TICK

As indicated by Nos. 5 and 5a of Figure 4, the body of the lone star tick (*Amblyomma americanum*) is oblong oval and of a yellowish-gray or brown color. The skin is rough and puckered unless the body is full of blood. The reddish-brown area at the front of the tick is composed of the head and head shield. The latter extends backward a short distance to form a triangle, in the apex of which is a white or metallic-yellow spot, from which it derives its name "lone star." (Fig. 4, No. 5b.) The mature female may reach one-half inch in length and has four pairs of long, thin legs. This tick has been found on cattle, dogs, horses, sheep, goats, hogs, and man, and is very widely distributed in the United States.

EAR TICK

As will be observed in Nos. 6 and 6a of Figure 4, the shape of the ear tick (*Ornithodoros mégnini*) is similar to that of the body of a violin. It is nearly twice as long as broad, rounded at both ends, narrower behind than in front, and slightly constricted in the middle. In color it varies from gray or brown to violet, and has two grooves behind the head, with a middle one in the posterior portion. On the skin of the back are numerous minute spines or stiff hairs. The adult females are from one-fourth to three-eighths inch in length, and have four pairs of long, stout legs. The anterior portion of the tick is curved downward to form a cover for the very small and short head, which can be seen only from the under side of the tick. The feelers (palpi) and beak, however, stick out from under the front part of the body and can be seen from above. (Fig. 4, No. 6b.) This tick is found in the ears of cattle, horses, mules, asses, and other animals in the South and West.

CHICKEN TICK

In shape and appearance the chicken tick (*Argas miniatus*) is like an enlarged bedbug, and is of a uniform, reddish-brown color, with four pairs of lighter-colored legs. The skin is wrinkled and contains very short and minute hairs. On the top as well as the bottom of the tick are numerous bright pits or cavities with raised borders. (Fig. 4, Nos. 7 and 7a.) These vary in size, are arranged in rows radiating from the center, more or less uniformly, and are usually symmetrical on each side. It is about three-eighth inch in size when mature. The head is so completely covered by the body that it can not be seen from the back. (Fig. 4, No. 7b.) This tick has been observed on cattle once only but is frequently found on chickens, turkeys, and other birds in the South.

EUROPEAN DOG TICK

The body of the European dog tick (*Ixodes hexagonus*) is oval in shape and of an ashy color. (Fig. 4, Nos. 8 and 8a.) The grooves on the back are united in an arch in front and diverge in the posterior portion of the body. The four pairs of legs are longer, thicker, and stronger than those of the cattle tick. The head and shield are brown red in color and similar in shape to those of the castor-bean tick but less oval and rather more lozenge shaped, with more acute lateral angles and narrower posterior angle. (Fig. 4, No. 8a.) The palpi, or feelers, are longer and more prominent than in the cattle tick but not so long as in the castor-bean tick. This tick has been collected from dogs, cattle, sheep, foxes, rabbits, squirrels, gophers, cats, birds, man, and other hosts in eastern United States.

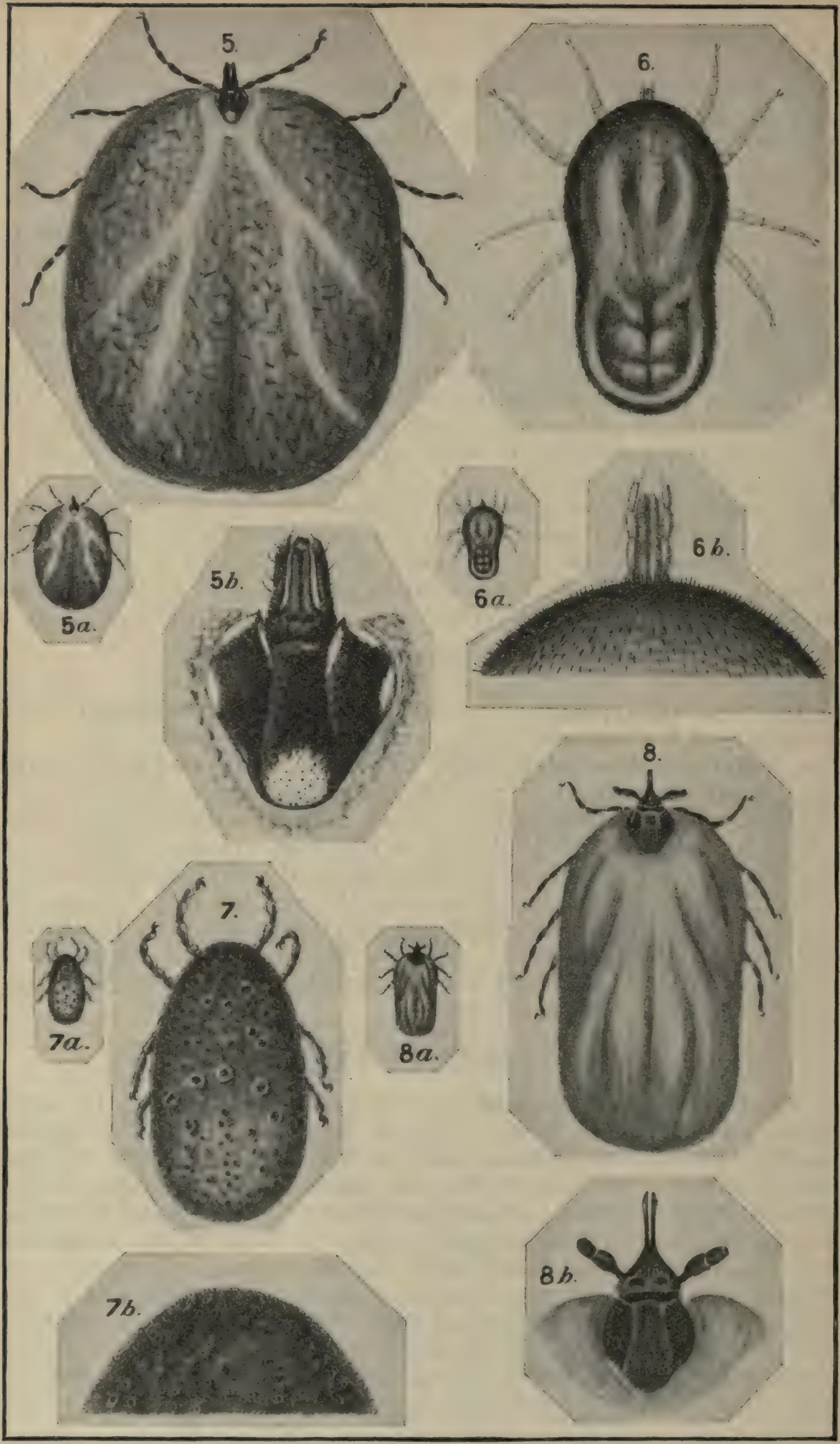

FIGURE 4.—Various ticks that infest cattle

SOME APPARENT EXCEPTIONS TO THE TICK AS A CARRIER OF TICK FEVER

TICK FEVER IN ANIMALS APPARENTLY NOT INFESTED WITH TICKS

One objection that has been advanced against the fact that the cattle tick is a carrier of tick fever is that cattle sometimes are found to be suffering with the disease without showing the presence of ticks on their bodies. This condition, in the case of southern cattle, may be explained on the hypothesis that the animal already had its blood infected with the microparasites and under normal conditions was immune from tick fever; however, as a result of lowered vitality caused by some other diseases, or by exposure, privation, injury, rough handling, etc., this immunity has become reduced and finally overcome, and the parasite of tick fever, dealing now with an impoverished condition of the animal, succeeds in producing tick fever. Since the experiments of the Bureau of Animal Industry show that the blood of an immune animal may contain this microparasite for at least 13 years after removal from all sources of infection, it would appear that this recurrence of disease in immune animals placed under adverse conditions could occur at almost any period of their lives, and may be termed a relapse. Thus it has been frequently noted that southern cattle, born and raised in infected pastures but later freed of ticks and placed on noninfected soil, have died of tick fever when their health was so weakened as to permit the parasites already infecting the blood to overcome the natural resistance of the body and produce the disease.

Again, in certain dipping experiments where the animals had been roughly handled and unduly exposed after having been dipped in a severely irritating solution, a few deaths occurred from tick fever among cattle which were known previously to have been immune—tick-infested southern animals—but whose vitality had been reduced through these extraordinary conditions.

On the other hand, when this disease is observed in northern animals, the young seed ticks may be so small and so few in number as to be passed readily by even a careful examination, yet numerous enough to cause the infection. In such cases the proof will be found either by prolonged search or in the fact that other animals subsequently take the disease with larger ticks apparent on the skin.

SOUTHERN CATTLE INFESTED WITH FEVER TICKS MAY DIE OF TICK FEVER

When cattle born and raised in the South die of tick fever, it is proof that they never came in contact with infected cattle ticks before, or that they were raised on tick-free pastures, or that they belong to those cases of immune southern cattle which lose their immunity when subjected to adverse or extraordinary conditions, such as those mentioned above. Otherwise they would have been insusceptible and would not have developed tick fever. Southern cattle, when raised and kept in districts free from cattle ticks, fail to secure the natural immunity induced by gradual and constant tick infestation from birth, and they are just as susceptible to the disease as are northern animals. Under certain conditions, as when living on horses, mules, etc., fever ticks lose their infectiousness, and when southern cattle not previously infected with any but these noninfected ticks come in contact with infected ticks they are just as susceptible as cattle raised on tick-free pastures, as indicated below.

HARMLESS TICKS MISTAKEN FOR FEVER TICKS

A very prolific cause for argument against the relation of ticks to tick fever has been the confusion which exists with reference to the various species of ticks observed on cattle. Some stockmen have claimed that ticks will not cause tick fever, because their experience has not been with the cattle ticks, but with the species of ticks described in the preceding pages, which are harmless so far as their ability to transmit tick fever is concerned, or with the noninfected cattle tick mentioned below. A similar experience with these harmless ticks on woodland far removed from cattle and the false assumption that they were cattle ticks have led others to claim that it would be impossible to eradicate the latter from infested pastures. However, their life histories are not parallel, since the cattle ticks demand the blood of cattle or equines in order to mature, while the ear, dog, lone star, and other ticks do not. Thus, if the fever ticks can be separated from these animals for a definite period they will die from lack of a host.

SUSCEPTIBLE ANIMALS HAVING FEVER TICKS WITHOUT TICK FEVER

In rare cases it has been observed that certain cattle ticks do not contain the Protozoa of tick fever, and when such ticks fail to produce disease in susceptible animals some persons have been led to argue that none of this species will transmit the infection. Cattle ticks without the virus of tick fever in their bodies are termed noninfected ticks. They may have lost their infectious property by living on a nonsusceptible animal, such as a horse, mule, ass, or suckling calf, as experiments have shown that a generation of infected ticks on these animals will eliminate the infection from their bodies, and when the next generation of seed ticks is placed on susceptible cattle no disease is produced. These ticks will become reinfected, however, if allowed to infest southern cattle containing the tick-fever Protozoa in their blood. Noninfected fever ticks are so very uncommon that it is necessary to treat all fever ticks as infected and capable of transmitting tick fever.

FEVER TICKS ON OTHER ANIMALS WITHOUT PRODUCING DISEASE

The reason that fever ticks can remain on animals other than cattle without producing the disease is because these animals are not susceptible to tick fever. Numerous experiments have shown that only bovines contract tick fever, so it is not difficult to understand why other hosts can be infested with impunity.

OTHER INJURIOUS EFFECTS OF CATTLE TICKS

Many cattle owners who have always been accustomed to see both ticks and ticky cattle on their farms are unfortunately not inclined to attach much importance to cattle ticks, and as a rule, through lack of appreciation of their damaging effects, placidly consider them as of little consequence. That ticks may be detrimental to their hosts in several ways has probably not suggested itself to these stockmen, and it therefore seems necessary to emphasize the fact that, in addition to their relation to tick fever, they may also be injurious to cattle as external parasites. While the power of transmitting tick fever is undoubtedly the most dangerous property possessed by the cattle tick and is the principal cause for adopting stringent measures in securing its complete eradication, nevertheless there still remain other good reasons for the accomplishment of this achievement. True, a few parasites may remain on cattle indefinitely without causing any noticeable effect, but it is not uncommon to notice bovine animals on pastures with their hides very heavily infested with these pests. In such cases it can readily be seen that the continuous sucking of blood causes more or less impoverishment of the circulation. The cattle must therefore be fed more heavily in order to meet the demands of the parasites in addition to the ordinary needs of the animals. This condition, together with the loss of blood, frequently induces an irritable state and evidences of uneasiness commonly known as "tick worry," which results in the loss of energy and in other derangements of the animals' health. It may in some cases become so pronounced, especially in hot weather, that the animal will lose flesh in spite of good pasturing, thereby reducing the vitality and rendering it more susceptible to the inroads of disease. Moreover, if the infestation of ticks is not controlled, the cattle may be so reduced in condition that growth is retarded, and in the case of young animals, they may never become fully developed but remain thin, weak, and stunted—a condition that has been termed "tick poverty"—and easily succumb to other diseases as a result of lowered vitality.

In milk cows this debilitating influence of the numerous ticks is shown in a greatly reduced milk supply. This should not appear strange when it is considered that some animals harbor many thousands of these bloodsucking parasites. If these parasites are crushed it will be found that their intestines are completely filled with a dark, thick mass of blood abstracted from the animal host and containing nutriment that should go to the formation of milk and flesh and the laying on of fat. In some rare cases the large number of bites over a limited area of skin may be followed by infection with pus-producing organisms, giving rise to small abscesses which may terminate in ulcers. The discharge from such sores, or in some cases the mere oozing of blood serum through the incision made by the mouth parts of the ticks, keeps the hair moist and matted together, and the laying and hatching of fly eggs in these areas give rise to infestation with destructive maggots, causing ulcers and other complications that require medical treatment.

These statements regarding the secondary injurious effects of cattle ticks also apply to those ticks which have been previously spoken of as harmless so far as tick fever is concerned, and in fact to all external parasites. Therefore, it is just as important to eradicate the cattle ticks for reasons other than those associated with tick fever as it is to exterminate lice, fleas, and other vermin. Furthermore, cattle ticks, aside from the losses sustained by their purely parasitic effects, are the greatest menace to the profitable raising and feeding of cattle in the South, because they are an obstacle to cattle traffic between the infected and noninfected districts.

LOSS OCCASIONED BY CATTLE TICKS

The economic aspect of the tick problem is unquestionably of the greatest practical interest, since the fundamental importance of all the other questions which surround it depends on the actual money value involved. A careful and conservative estimate made in 1906 placed the annual loss caused by the ticks in the United States at $40,000,000 and indicated that the ticks also lowered the assets of the South by an additional $33,000,000. Present losses are materially less, however, as the quarantined area is now only about one-fifth its original size and is being reduced each year as tick eradication extends into new areas. The principal items of loss in the regions still infested with ticks are set forth below.

Since May 1, 1928, the interstate shipment of tick-infested cattle for any purpose has been prohibited, making necessary the trouble and expense of dipping and freeing cattle for shipment. Formerly animals coming from an infected district and sold in the southern pens at northern markets brought from one-half to 1½ cents a pound less than the quoted market prices. The handicap that was thus placed on cattle raisers as a result of this decreased value of the stock averaged at this figure from $3 to $9 a head, allowing an individual weight of 600 pounds for all classes of animals. This decreased value reacted and fixed the valuation of all cattle in the infected territory, thereby reducing the assets of the cattle industry of that section. In addition there is a very heavy loss from the decrease in flesh and lack of development of southern cattle occasioned by the parasitic life of the ticks from without and by the blood-destroying and enervating properties of the protozoan parasites within.

The presence of the tick among cattle not only lessens the value of the cattle on the hoof but causes the gradings of the hides that have been infested with ticks as No. 4 quality. The same hide, if free from tick marks, would grade No. 2. The difference in price between these two grades of hides is from 3 to 5 cents a pound. As the hide of a steer weighs about 42 pounds, the presence of the tick causes a loss in the hide alone of from $1.25 to $2.10 a hide. The increase in the value of the hide alone would more than pay the cost of tick eradication.

The shrinkage in milk production of cattle harboring many ticks will average 1 quart a day, which in the aggregate is a heavy loss. The damage resulting to the southern purchaser of northern purebred or high-grade cattle has been another item of no small moment. About 10 per cent of such cattle taken into tick-infested areas die of tick fever even after they are immunized by blood inoculations, and about 60 per cent of them succumb to tick fever when not so treated. As they are usually expensive animals and of a highly valuable strain of blood the loss in certain cases is excessive and in others almost irreparable, owing to the possible extinction of some particular type especially selected for the improvement of the herd.

Another instance in which it is difficult to figure the injury done by the ticks is in the case of death of nonimmune cattle in the tick-free pastures of the quarantined area. Such animals are as susceptible to tick fever as nonimmune northern cattle, and inasmuch as there are in many States numerous tick-free pastures within the quarantined areas the possibilities of loss following exposure to ticks are apparent. These losses can scarcely be computed, as the death rate depends so much on the season of the year when exposure occurs and on the age of the animal affected. However, the deaths among such cattle are considerable, although this fact is little appreciated or understood by many outside the infected area.

On rare occasions a small outbreak of tick fever occurs north of the quarantine line as a result of improperly disinfected cars, of unscrupulous dealers who break quarantine regulations, or of some accidental condition. Such damage, however, is slight, but should be considered in summing up the loss occasioned by the fever tick. A heavy expense is also incurred by the Government and the States in enforcing the regulations that apply to the quarantine area. Another loss which is indirectly sustained by the southern-cattle industry through increased freight rates is the cost, to the railroad companies, of cleaning and disinfecting the cars that carry ticky cattle.

These statements are sufficient to indicate that the loss to the quarantined section from the cattle tick has been enormous. Such a series of encumbrances as those recorded could be carried by the cattle industry of no other section of the country than the South, whose excellent pastures, rich soil, and salubrious climate are the only reasons for its ability to overcome such obstacles in meeting the competition of the West. And it is the inherent capacity of the South for greatly increasing its herds and enlarging its pasture lands that makes the actual loss even secondary to the potential loss from restrictions necessitated by the presence of the cattle tick.

These appalling losses and annual sacrifices of the cattle raisers of the infected district can be entirely effaced, and at a small proportionate cost; for, with enthusiastic stockmen, satisfactory State legislation, sufficient money, and a corps of trained inspectors, the cattle tick may be exterminated, and every dollar expended in this work will be returned many times during the succeeding years.

PERIOD OF DEVELOPMENT OF DISEASE AFTER EXPOSURE TO TICKS

The length of time elapsing between the exposure of susceptible cattle to the cattle tick and the appearance of tick fever among them is dependent on the climate and the development of the ticks. Thus, if any northern animals are placed upon pastures, highways, or in pens, cars, etc., in summer immediately after the premises have been infested with the ticks from southern cattle, tick fever may occur in from 30 to 60 days, as the females that drop from the southern cattle must lay eggs and these must hatch before the northern animal becomes infested with ticks and thereby inoculated with the disease. In cool weather this period may extend to 90 days, as it takes much longer for the eggs to hatch. Where northern animals are not exposed in an infested pasture until the ticks which fell from the southern cattle have laid eggs and the larvæ, or seed ticks, are already present, the northern cattle will develop symptoms in 13 to 15 days in hot weather. Thus under natural conditions the disease appears in 13 to 90 days after exposure. After the seed ticks become attached to the animal the disease will appear in about 10 days in summer, and after a somewhat longer period in cooler weather. In fact, the disease may occur before the ticks are large enough to be seen without a very careful search. By artificially inoculating a cow under the skin or into a vein with virulent blood the disease may be produced in 3 to 10 days.

SYMPTOMS

The symptoms of tick fever present two distinct types, the acute and the chronic, depending on the time of year the disease makes its appearance and the susceptibility of the animals attacked.

ACUTE TYPE

In the acute form of the disease the temperature rises within 24 to 48 hours to 107° or 108° F., and the animal rapidly shows signs of being affected with a severe malady. It is depressed, leaves the herd, and lies down or stands off by itself with head lowered, ears dropped, feet drawn together, and back arched from the pain in the liver and kidneys. The muzzle is dry, the appetite lost, and rumination ceases. Constipation is always present during the first stages of the disease, but it frequently gives place later to diarrhea, and the manure is usually heavily stained with bile and in rare cases may be mixed with blood. The number of respirations may rise to from 50 to 90, while the pulse beat varies from 90 to 120 per minute.

The changes which occur in both the urine and blood are extremely important, but the urine will receive first consideration here, as it is more readily examined by the layman than the blood. The peculiarity of the urinary secretion is that it is bloodstained, from which symptoms the disease has derived its name of "red water." The Protozoa in the circulation break up the red corpuscles, liberating the hemoglobin, which is the coloring matter of the blood. This discoloration of the urine is present in the majority of the acute cases, but it is frequently wanting in the chronic form of the disease. The color varies from a mere pinkish tint to an almost black color, depending on the rapidity of destruction of the red cells and the excretion of the coloring matter through the kidneys into the urine.

The blood also furnishes great assistance in making a diagnosis of suspected tick fever, and the finding of the intracellular parasite microscopically is conclusive evidence. The blood, as it oozes from a small incision in the skin, is pale and watery, indicative of great reduction in the cellular element, and is readily seen to differ markedly from the normal red blood of healthy animals. Sometimes there is such a lack of blood in the vessels of the skin that a very deep incision has to be made in order to obtain sufficient blood for inspection. It is also at times noted that the power of the blood to coagulate is so reduced that when it once starts to flow it is only after a considerable time—or by applying pressure—that the hemorrhage is stopped. In the majority of cases, however, the tendency of the blood to clot is unaffected.

Cerebral symptoms are noticed in a certain percentage of cases, manifesting themselves in the form of staggering gait, disturbances of vision, or delirium. There is in milk cows a reduction or a complete stopping of the milk secretion. Abortion is also very common in pregnant animals. Death usually occurs within three or four days, and is generally preceded by a marked fall of body temperature to normal or even subnormal a few hours before the fatal termination. In nonfatal cases the temperature falls gradually after the crisis and soon reaches the normal, but recovery is prolonged over weeks and even months, as a great deal of time is required to regenerate the greatly impoverished blood.

CHRONIC TYPE

The chronic form of the disease appears under natural conditions usually in the late autumn and early winter. It can be produced experimentally, however, by placing a few ticks on the skin of a susceptible animal—a fact of very great importance in the production of immunity against the acute type among northern cattle.

This form shows all the symptoms of the acute type, but in a milder degree. The temperature usually remains about 103° and never exceeds 105° F. There is loss of appetite, stoppage of rumination, constipation, and albumin in the urine. An anemic condition of the blood, as indicated by the pale and bloodless mucous membranes, is also present, but hemoglobin is not usually excreted by the urine; hence the red-water symptom is absent. There is also excessive loss of flesh and before the end of the attack, the affected animal is greatly emaciated. Although death rarely occurs, the valuation of the animal is much reduced.

RELAPSES

Following recovery from an acute attack, when the red blood cells have apparently reached their normal number, there has frequently been observed a relapse or recurrence of the disease in the mild, chronic form, accompanying which there is a second period of destruction of the red cells. This follows within three to six weeks after the symptoms of the acute attack have subsided. For a considerable time it was unknown whether this was a relapse of the acute attack or due to reinfection from a second generation of ticks. Smith and Kilborne, however, proved that it could occur as a relapse without the presence of ticks, but that it may also in some cases be caused by a second extraneous infection. In some cases the apparent relapse is probably the occurrence of anaplasmosis following a simultaneous infection with this disease and tick fever. The fever and other symptoms of anaplasmosis occur after the acute symptoms of tick fever have subsided.

APPEARANCE AFTER DEATH

The post-mortem examination should be made as soon as possible after death, as the carcass of an animal dead of tick fever undergoes decomposition very rapidly. The skin should always be first examined for the presence of the cattle tick, as the discovery of any of the forms of this parasite on the skin of the escutcheon, thigh, or belly leads at once to a suspicion of the presence of the disease. The skin is usually normal in appearance, no visible alterations being present except possibly the small swellings, minute hemorrhages, and perforations from the bites of the ticks. Upon cutting into the hide and skinning the carcass a marked lack of blood in the blood vessels of the skin and underlying tissues is observed. Occasionally there may be noted a yellowish, jaundiced discoloration of these tissues. This is due to the alteration of the bile-secreting function of the liver, but is by no means present in all cases, being most constant in the acute, rapidly fatal form of the disease.

Probably the most marked pathological alterations in the disease are found in the liver. This organ is very much enlarged and has a yellowish, mahogany-brown color, due to the bile it contains. This secretion becomes excessive and minute plugs of congealed bile form in the small bile ducts, thus stopping them and damming the bile in the organ, which produces the yellowish color. This does not occur evenly throughout the organ, and consequently it has a mottled appearance. The gall bladder is usually distended with bile and its mucous membrane often contains numerous minute hemorrhages or bloodshot spots. The bile is very thick, has the appearance of "chewed grass," and contains numerous firm, irregular flakes. The spleen also shows marked changes. Normally this organ weighs from 1½ to 2½ pounds, but in cases of tick fever it is enormously enlarged, sometimes reaching four times its normal dimensions. It is very dark at times, due to the enormous accumulation of red cells and hemoglobin within its substance. On cutting into it the pulpy tissues will sometimes run out as a semifluid, blackish mass, due to the breaking down of its structures.

In death from the acute type of the disease the kidneys are usually found to be very dark in color and congested. The blood vessels are engorged with blood and there is watery infiltration of the surrounding fatty tissue. In the older, more chronic cases the kidneys are paler and somewhat flabby.

The bladder usually contains a varying quantity of urine, which may or may not be bloodstained. The mucous membrane frequently contains a few minute hemorrhages.

No characteristic lesions are found in the stomach, intestines, heart, or the lungs.

COURSE AND TERMINATION OF THE DISEASE

The course of the disease depends not only on the time of the year the infection occurs, but also on the age, strength, and susceptibility of the animals attacked. When mature, susceptible cattle contract the disease in the hot summer months, death usually occurs within a week—generally 3 or 4 days—after the first appearance of symptoms, but it may follow inside of 24 hours.

In the infections of partially immune southern cattle and when nonimmune cattle are infected in the late fall, however, the course of the disease is much more prolonged and covers a period of many weeks or even several months. In this type the continuous fever causes exhaustion, while at the same time the enormous destruction of red blood cells interferes very materially with the nutrition of the patient. As a natural consequence emaciation becomes marked, and this, together with the poor appetite, leads to a fatal result in some cases. In the majority of cases, however, in spite of the severe alterations of the blood and internal organs, the animals begin after several weeks to show improvement. The temperature becomes normal and there is a tendency toward regeneration. This, however, requires weeks and months, the animals in the meantime appearing weak and thin, having pale mucous membranes. During the recuperative period the animal should by no means be fed excessively, as numerous cases of fatal gastrointestinal disturbances have been reported from overfeeding. The few animals which recover from the acute type of summer are quite likely to have a relapse in the form of the chronic type in the fall.

The mortality in adult susceptible cattle, as the statements above readily show, may vary considerably, and ranges from 90 per cent in the months of July and August to less than 50 per cent in the late autumn and early winter. The prognosis must therefore depend on the time of year the outbreak occurs. In animals under 9 months of age the course of the disease is usually short and the affection seldom fatal, while the death rate among 1-year-old cattle during the hot season is about 25 per cent and less than 10 per cent in the fall and winter. Between 1½ and 2 years of age the mortality is about double that at 1 year.

INFECTIVE CHARACTER

Tick fever belongs to the group of infectious diseases, and it is a typical example of the few diseases of this class which do not have the property of being contagious. It is infectious because it is due to the entrance and multiplication of a pathogenic microorganism within the body, but sick animals, in the absence of ticks, can remain in intimate association with healthy, susceptible animals indefinitely without transmitting the disease to them, and hence it is not contagious. Furthermore, a cow perfectly healthy in appearance may contain in its blood the tick-fever protozoan, which, when transmitted to susceptible cattle by the fever tick, will produce the disease. It is certain that the organisms are present in varying numbers in the manure and urine of infected animals, and yet susceptible animals have never been known to become affected from grazing over tick-free pastures soiled with excrement from sick animals.

The experiment was made by the Bureau of Animal Industry of polluting a pasture with the blood and spleen of an animal dead of tick fever and then allowing susceptible cattle to graze in the field for two months, but the animals remained perfectly healthy. Moreover, the feeding of ground-up ticks and virulent blood failed to produce the disease, showing that the digestive tract is proof against the infection.

The disease therefore can be transmitted by three known methods only: (1) By the bite of the cattle tick; (2) by inoculating the blood of sick animals into healthy animals; (3) by inoculating the infected blood of apparently healthy southern cattle into nonimmune cattle.

ANIMALS AFFECTED

Numerous experiments have been made on various species of animals with highly virulent blood from cattle suffering with tick fever, but the disease has been produced in bovines only. Among those animals that have failed to develop the disease after inoculation may be mentioned horses, asses, sheep, pigs, dogs, cats, mice, rats, guinea pigs, rabbits, chickens, and pigeons. All bovine animals that have never been exposed to the disease are susceptible to tick fever, although sucking calves are so resistant as to be practically immune. Adult cattle are the most susceptible, and, if attacked in the summer months, usually die, while in the fall and winter they more frequently recover. Calves under 8 months of age contract the affection in a very mild form, as a result of which they become immune from the disease.

DISEASES MISTAKEN FOR TICK FEVER

The three diseases which may be confounded with tick fever are anthrax, blackleg, and anaplasmosis. The following are the main features of tick fever not found in anthrax: Young ticks are usually found on the hide of the affected animal; if occurring in the uninfected territory, the disease can invariably be traced to the shipment of southern cattle into the locality 30 to 90 days previously; young sucking calves as a rule are not affected; the mucous membranes become extremely pale and jaundiced, while in anthrax they are very red and congested; cattle only are attacked, while anthrax attacks all animals. On post-mortem examination in tick fever the tissues under the skin are very pale, while in anthrax they are congested, with the blood vessels standing out prominently. The blood is thin, pale, and watery, whereas in anthrax it is tarry, black, and incoagulable. The bile is semisolid and contains numerous hard flakes, while in anthrax it is fluid. The spleen is affected somewhat similarly in both diseases, but the liver in tick fever is enlarged, yellowish, and mottled from the plugging of the bile ducts, whereas in anthrax the liver, although enlarged, is very dark in color and is congested.

Tick fever can usually be differentiated from blackleg by the fact that the great majority of victims of blackleg are between 6 months and 2 years of age. There is usually a total absence of ticks on the hide in the latter disease, while there are present superficial, crackling swellings which on being opened are found to contain gas bubbles with the peculiar odor characteristic of the disease. There is also an absence of bloodstained urine. On post-mortem examination in blackleg the muscular tissues beneath the swollen areas are very dark and soft, with bloody fluid, while the liver, spleen, and kidneys are apparently unaffected.

Anaplasmosis, which in many respects resembles tick fever, has been recognized in recent years in a number of the Southern and Western States (California, Louisiana, Florida, Oklahoma, Kansas, Nevada, Texas, Arizona, and Missouri, and it possibly occurs in some others). As in tick fever, a microparasite in the red blood cells is the causative agent. In certain foreign countries several kinds of ticks, the blue tick (*Boophilus decoloratus*), the black tick (*Rhipicephalus simus*). the tropical cattle tick (*B. australis*), and the castor-bean tick (*Ixodes ricinus*) have been shown to be capable of transmitting the infection. Apparently the American cattle-fever tick carries the disease within the tick-fever area, but the transmission of uncomplicated cases of anaplasmosis by this tick has not yet been experimentally demonstrated in this country, and it is evident that the transmission of the disease outside of this tick area is not due to the cattle-fever tick.

In the United States anaplasmosis has been found in tick-free sections, and the manner of spreading the disease is not definitely known. The course of the affection is usually acute and the mortality from 20 to 60 per cent. The symptoms consist in suppression of the milk flow, loss of appetite, marked weakness, stiff gait with a tendency to lie down frequently, and often a high fever. There is usually a decided constipation, but at times a diarrhea. The urine is generally normal in appearance, not blood-tinged as in tick fever. The pulse is rather rapid, and likewise the breathing, which is accomplished with grunting sounds. The membranes of the mouth and eyes are very pale and may have a marked jaundiced appearance. There is always a considerable falling off in condition, the affected animal having a very gaunt appearance. Death may occur in from a few days to a week or more after the animal gets down. Many cases recover, but it is usually several months before such animals regain their normal condition. On post-mortem examination there is found a marked spotting of the heart, heart sac, and inner surface of the chest walls with small hemorrhages. The liver is usually enlarged and the gall bladder distended with thick bile. The spleen is greatly enlarged, softened, and dark colored. The white tissues of the body may have a yellowish cast. The blood is thin and watery and under the microscope shows the small dot-like microparasite, *Anaplasma marginale*, in the red blood cells.

PREVENTION

It is generally accepted that if southern cattle are entirely free from that species of tick known as *Boophilus annulatus* they can be allowed to mingle with the most susceptible animals without danger. Furthermore, it has been learned from the study of the life history of the cattle tick and from the fact that this tick infests pastures only transiently, never permanently, and will not mature except upon cattle or equines, that its extermination is possible, and that the disease it causes may be prevented. Therefore the various methods with these results in view should be directed toward the destruction of ticks on cattle as well as their eradication from the pastures.

The details of these methods of eradication will not be discussed here, as this subject is fully treated in Farmers' Bulletin 1057, Cattle-Fever Ticks and Methods of Eradication, which may be obtained free upon application to the Department of Agriculture, Washington, D. C.

IMMUNIZATION OF SUSCEPTIBLE CATTLE

BY BLOOD INOCULATION

Medical treatment of animals sick with tick fever has usually been unsatisfactory. In the United States it is generally believed that this disease will be satisfactorily and finally disposed of only with the complete eradication of the cattle tick and all official work since 1906 has been with this end in view. However, it is sometimes desirable to export to tick-infested countries or ship well-bred cattle into infested districts that they may be used to improve the quality of the native cattle already there. Before the discovery of the cause of tick fever it was found to be well-nigh impossible to introduce purebred cattle from the North into any of the infected regions without suffering great loss—sometimes as high as 90 per cent—within a few months of their arrival at their southern destination. It has now been found practicable to immunize this class of cattle so perfectly that the losses which follow their transportation to a tick-infested region are reduced to a minimum. Young animals 6 to 15 months old should, so far as possible, be selected for this purpose, as they are more readily immunized than adults, are more easily handled, and the dangers which may arise from pregnancy while undergoing the immunizing treatment are thus avoided.

Immunity in these cattle is obtained by introducing the microparasite of the blood into their systems. It may be done by direct artificial inoculation or by placing virulent young ticks upon the animals and allowing them to perform the inoculation in the natural manner. The subcutaneous injection of a small amount of defibrinated, virulent blood has been found, by means of prolonged experiment, the preferable method, as the number of microorganisms introduced can be more accurately gauged from the syringe than by allowing the infection to be produced by bites of ticks. Two or three inoculations, if repeated at proper intervals, are accomplished with greater safety to the animal than would be possible by means of a single inoculation. The amount first injected should be small and then gradually increased in the succeeding treatments.

The inoculation always results in a more or less serious attack of tick fever. Besides having a fever, there is a great diminution of red blood cells, and in about 3 per cent of the cases a fatal termination; but the proportion of deaths resulting from the inoculation is small when compared with the fatalities among untreated animals taken into infested districts. To this number should be added those animals (less than 7 per cent) that do not receive sufficient immunity by this method and succumb when exposed to infested pastures. Combining these failures it will be seen that by this method of immunization, instead of a loss of 90 per cent among breeding stock taken South more than 90 per cent can be saved. The animals should be carefully nursed through the attack and treated symptomatically. The intravenous injection of 100 to 200 cubic centimeters of a 1 per cent solution of trypan blue will be found beneficial in these cases, as it serves to control the severe reaction and to reduce the loss from immunization.

Immunizing inoculations are now being made by the veterinarians of some of the agricultural experiment stations of the Southern States without cost for the services rendered, a charge being made merely for the actual value of feed consumed by the animals and attendants' wages. These veterinarians have also issued station bulletins which describe fully the necessary steps to be taken in securing the blood and injecting it into the animals to be immunized, so that the stock owner can follow the instructions with prospects of getting good results.

This operation is not a difficult one, and excellent results will follow where absolute cleanliness and ordinary care have been used, but undoubtedly the best results will be obtained by those who have thoroughly familiarized themselves with the nature of the disease and are experienced in extracting blood from animals. Two methods are in use and will be described separately. One consists in drawing the blood from the jugular vein of an immune animal and immediately injecting it into the cattle to be immunized. It is comparatively simple, requires few instruments, and can be satisfactorily carried out where a small number of animals are to be immunized and if a suitable immune animal is close at hand. First, select an immune animal which is in good health and is infested with fever ticks or had them the preceding year. Fasten the animal securely, either by tying, throwing, or by placing in a chute. Clip the hair from a space about 4 inches in diameter over the jugular vein on the upper third of the neck, wash the skin thoroughly with a 5 per cent solution of carbolic acid, and then fasten a strap or rope around the neck below the hairless area and draw it tight in order that the blood in the vein will be stopped, causing distention. With a large, hypodermic syringe needle, previously sterilized in a 5 per cent carbolic-acid solution, puncture the vein at a slight angle, directing the point forward. When the needle enters the vein the point can be rotated freely in contrast to the restricted movements if still in the tissues, and the blood will either drop or flow from the opening in the needle. Attach the disinfected syringe to the needle with piston in and gradually draw out the piston until the chamber of the syringe is full of blood, when the needle is withdrawn. From a yearling in fair condition a pint of blood may be taken without harm, while double this quantity may be taken from a 2-year-old, and four or five times as much from a 3-year-old or upward. The blood, before it has had time to clot, is immediately injected into the animals to be immunized, which have been previously tied or restrained, the hair clipped, and the skin disinfected at the seat of injection in the region of the shoulder. Inject then from 1 to 3 cubic centimeters, according to the age of the animal, under the skin of each animal until the blood is exhausted. When more animals are to be inoculated than one syringeful will inject, the operation may be repeated in the same manner. The only objection to this method is the possibility that the blood will clot in the syringe, but with practice and promptness this can be easily overcome.

The second method is better suited for the inoculation of a large number of cattle or where the immune animal is at a distance from the cattle to be immunized.

The preliminary steps—the clipping of the hair, disinfection of the skin, placing the rope around the neck to distend the jugular vein, and restraining the animal—are the same as for the first method. In puncturing the vein it is advisable to use a small trocar and cannula after sterilization in a 5 per cent carbolic-acid solution, and, when the vein has been entered, to draw out the trocar, allowing the blood to flow through the cannula attached to a rubber tube into a perfectly clean and sterile vessel containing a 5 per cent solution of citrate of potassium or sodium, to prevent the coagulation of the blood. The amount of citrate solution in the container should be one-twentieth of the quantity of blood which it is desired to collect. After sufficient blood has been drawn for the animals to be injected, a cork is placed in the top of the bottle, through which passes a long, rubber tubing. At the other end of this tubing is a needle, and in the middle is a T joint with a syringe at the stem of the T. By the use of valves at this joint the withdrawal of the syringe piston pulls the blood from the bottle, and the insertion of the piston with closure of the opposite valve ejects the blood from the needle. The citrated blood is inoculated under the disinfected skin of the animals to be immunized as in the first method. This blood may be kept in a dark, cool place for one or more months without deteriorating and may be shipped to other points for use.

The place where this injection is made is immaterial, but for convenience a point just behind the shoulder is usually chosen. The dose and number of injections vary with the individual animals. When a large number of cattle are to be inoculated a special form of syringe devised by Pound, of Queensland, may be used. (Fig. 5.) The syringe is so arranged by means of tubes and valves that by simply pulling out the piston of the syringe and pushing it in again the correct amount of blood is drawn up from the bottle and injected through the needle into the animal, thus obviating the necessity of continually filling the syringe and measuring out the dose. As a rule, it may be stated that 1 cubic centimeter should be injected into an old animal coming into the infested district, 2 cubic centimeters for a 2-year-old, and 3 cubic centimeters for an animal 9 to 15 months old. It will be observed that, unlike the usual custom of applying treatment, the older animals take less than the young ones, owing to their greater susceptibility to the disease. Where an animal has reacted well to a first injection and shows a very high temperature, great reduction of red blood cells, or other symptoms indicative of reaction, it will not be necessary to repeat the injection; but in

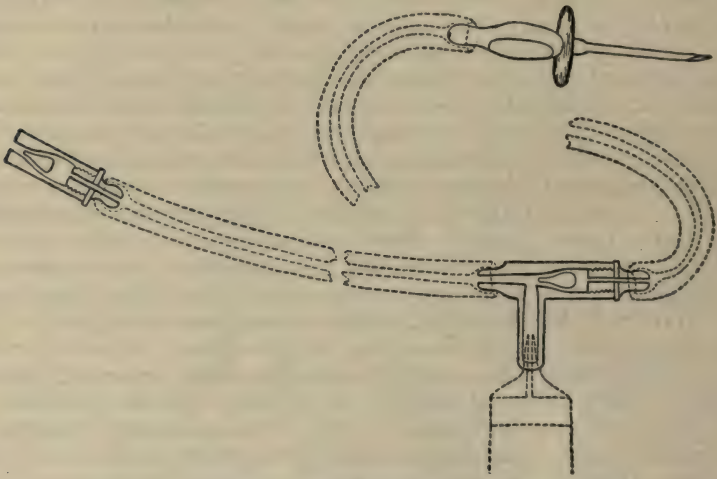

FIGURE 5.—Syringe for injecting blood

those cases where the reaction is slight a second injection should follow after an interval of 40 days, and, if need be, a third injection after a similar lapse of time, always increasing the size of dose 50 per cent. A thermometer, to indicate the course and severity of the disease, is indispensable in this work. Usually after 3 to 10 days, sometimes longer, the inoculated animals show a mild type of tick fever, which runs a course of from 6 to 8 days and is followed in about 30 days after the injection with a second attack of a milder character than the first. After 40 days, when the animal has entirely recovered from the inoculation, a second injection may be given to increase its immunity. In some cases a very severe type of fever follows the first inoculation, requiring careful nursing, symptomatic treatment, and the intravenous injection of 100 to 200 cubic centimeters of a 1 per cent solution of trypan blue. A second, milder attack follows, usually in about 30 to 40 days, after which the animal need have no further inoculations. It is advisable to prevent any ticks from getting on the cattle until 60 days after their inoculation or until they have fully recovered, at which time a few ticks may be placed upon them in order to reenforce their immunity. Naturally, this time varies according to the type of the attack. As the best results with these immunizing experiments have been obtained in cool weather and with young cattle, it is recommended that animals from 6 to 15 months old be selected for inoculation, and that they be immunized during the late fall or winter months in order that they may enter tick-infested pastures in the spring without danger.

BY INFESTING WITH TICKS

Immunity may also be induced in susceptible animals by placing a limited number of fever ticks upon their bodies in order to produce the disease naturally. For this purpose only animals less than 1 year of age should be used, as the method is not applicable for older and more susceptible animals. On the bodies of these young cattle from 25 to 50 seed ticks should be placed, which in the course of about 10 days will occasion a rise of temperature and a mild form of tick fever. When the animal has entirely recovered from this attack, a second crop—double the number first used—should be applied to the animal in order to increase its power of resistance when pastured on infested soil. In order to carry out this method successfully a constant supply of seed ticks must be at hand. This can be accomplished by placing the mature females in a Mason fruit jar among some dirt and leaves and keeping them in a warm place. In a few weeks the eggs will have been laid and hatched, and a number of seed ticks will be present for use in infesting the cattle to be immunized. By placing a few adult females in the jar every two months there will always be a supply of these young ticks. This method of producing immunity by controlled tick infestation is not so safe as blood inoculation, since the quantity of germs injected can be more accurately regulated by means of a syringe.

FEDERAL SANITARY REGULATIONS

The sanitary regulations which have been made by the Department of Agriculture for the control of cattle shipments from the infected districts have for their initial purpose the prevention of the transportation of cattle ticks from infested regions to those that are not infested, whether on cattle or in stock cars or other conveyors. They are based on the fact that tick fever is carried only by the cattle tick; and the exclusion of this parasite from the noninfected territory has in every instance been found a certain method of excluding tick fever.

The regulations define the boundaries of the infected districts and prescribe the treatment required to render cattle tick free and safe for movement from these infested areas. In consequence of the enforcement of these quarantine regulations tick fever has been practically prevented in the noninfected districts during recent years, and little or no hardship has been caused to the stockmen handling cattle from the infected areas. Before the regulations were established the tick-infested district was rapidly extending northward, but since the quarantine line was established and rational regulations enforced in conjunction with the systematic tick-eradication campaign the quarantined area has been reduced to one-fifth of its original size. This problem of still further reducing the infected area is of the greatest importance to the cattle industry of the South, in fact, to the whole country, and is receiving special consideration by this department as well as by all of the interested States.

OTHER IMPORTANT MEASURES FOR REDUCING THE INFECTED AREA

The first and probably the most important step in eradicating the cattle tick is to start and continue a plan of educating the cattle owner as to the nature of tick fever and the method of its transmission. This may be best accomplished through farmers' institutes, motion pictures, the issuance of press bulletins and circulars, the publication of articles in agricultural journals, and, best of all, by personal intercourse between the agricultural population and stock inspectors who are capable of imparting the necessary information. There can be no doubt that the crying need of the infected country is not so much the development of new ideas for exterminating the cattle tick as it is to remove all doubts of stockmen regarding what they term the " tick theory," and to impress upon them the fundamental truths concerning the cattle tick, its relation to tick fever, and simple methods for its extermination. In some counties within the infected district the local authorities have organized cattle clubs composed of stockmen, with the view of interesting them in exterminating the ticks from their premises and in preventing cattle in adjoining tick-infested sections from coming upon their property. These organizations are the means of disseminating general information respecting tick-fever infestation and the cause of the restrictions placed on cattle in the infected district, and through them a concerted action of the cattle owners is obtained, resulting in the control and final eradication of the infection within a portion or the whole of a county. The success of such clubs is a constant reminder of what other organized stockmen could do.

All the infected States have enacted laws providing for the eradication of the cattle tick, which if supported by adequate appropriation and given the cooperation of the cattle owners, will soon result in exterminating the fever tick from the remaining infested areas of the country. Cattle from any section of the South may then be shipped to the tick-free areas of the North without restraint, thus supplying the increasing demand of the Northern States for grazers and feeders. Prices would then be higher and the demand greater. Purebred northern cattle could then be brought into the South to improve the native stock, without danger of death from tick fever, and the total cost of tick extermination will be far less than the amount saved in the first year after it has been accomplished.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

March 25, 1930

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